Compressed Air Magazine

Vol. 43, No. 4 London - New York - Paris April, 1938

CONTINUOUS HOT STRIP MILL

ON THE COVER

THE cover picture was taken in the Jones & Laughlin Steel Corporation's new strip mill which is described in an article starting on page 5572. The slab of steel in the center has just passed through the four roughing stands and is approaching the finishing train of six stands of rolls in the background. The slab at the lower left is entering the last of the four roughing stands.

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IN THIS ISSUE

CONTINUOUS-TYPE rolling mills in operation and under construction in the United States have an aggregate annual capacity of 9,000,000 tons of steel plates, sheets, and strip. These products are used for making hundreds of articles, ranging from tacks to stovepipes and from steel drums to automobile tops. Although the machinery that constitutes a modern continuous strip mill is ponderous, nevertheless it operates with almost unbelievable precision despite its high speed. Our leading article describes one of the newer mills of this kind and points out the numerous ways in which compressed air contributes to its operations.

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THE Mexican government is taking steps to profit by the vast agricultural potentialities of the country south of the Rio Grande by supplying water to extensive tracts of land in semi-arid regions. Juan J. Ortega, one of the engineers in charge of the project, gives a general description of the purpose and nature of three large dams that are now under construction there.

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A CONTRACTING company faced with the problem of removing 32,000 cubic yards of rock from one short highway cut in Westchester County, New York, did the job in about 45 working days. Much time was devoted to planning the attack so as to save drilling; and the scheme adopted served to break up the rock with a small amount of drill hole per cubic yard. Details are given in the article, *Roadbuilders Turn Quarrymen*, beginning on page 5586.

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1937 INDEX

THE index to volume 42 will be mailed to any reader upon request.

Compressed Air Magazine

Volume 43 **APRIL, 1938** Number 4

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EDITORIAL CONTENTS

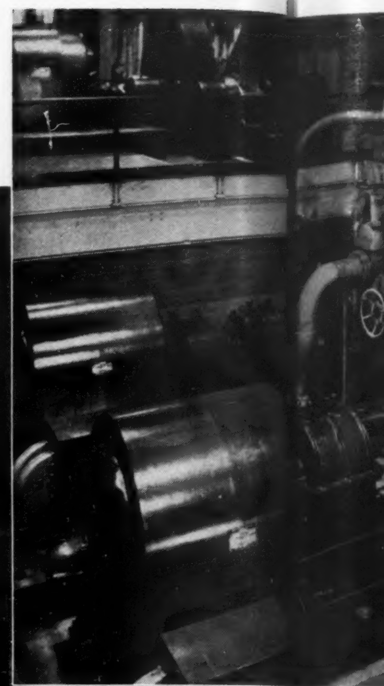
ADVERTISING INDEX

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

Published by Compressed Air Magazine Company. G. W. Morrison, president; R. A. Lundell, vice-president; F. E. Kutz, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index.

Producing Steel at 20 Miles an Hour

C. H. Vivian



IT IS an enthralling sight to watch a white-hot slab of steel weighing 3 tons or more slide out of a furnace, then move, as though borne by invisible hands, through a series of gigantic sets of rolls, and emerge as a long strip of red-hot metal traveling at a speed of 30 feet or more a second. Shorn of details, that is what takes place in a continuous hot strip mill, one of the newer marvels in steel-making.

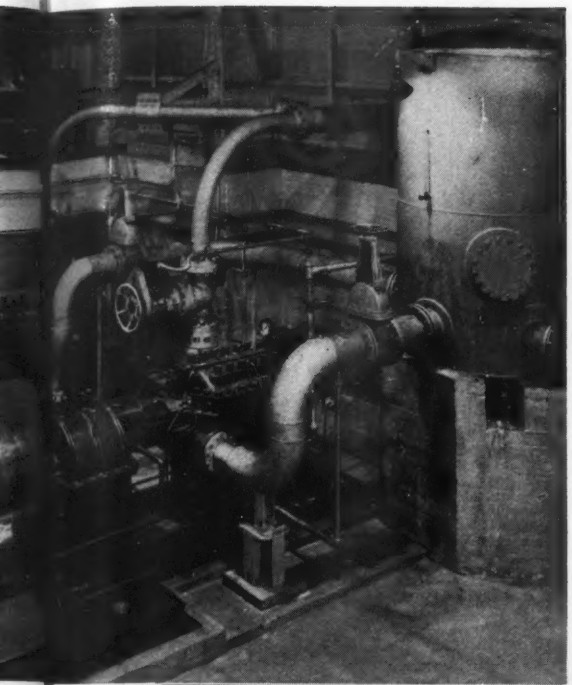
Products of such mills are widely used. The top of your automobile, its body, fenders, and many other parts came from one: likewise the frame and cabinet of your mechanical refrigerator and essential parts of your radio, metal furniture, and many other articles that are in general use. In a normal year the automobile industry alone utilizes well over 1,000,000 tons of hot-rolled sheets and the same quantity of cold-rolled sheets which were first hot rolled. The turret-top car owes its existence to improved steel-processing methods that provide the automotive industry with materials far superior to those of as little as five years ago. These improvements have been so great that rejections of defective sheets have been reduced from around 30 per cent to as little as 3 or 4 per cent.

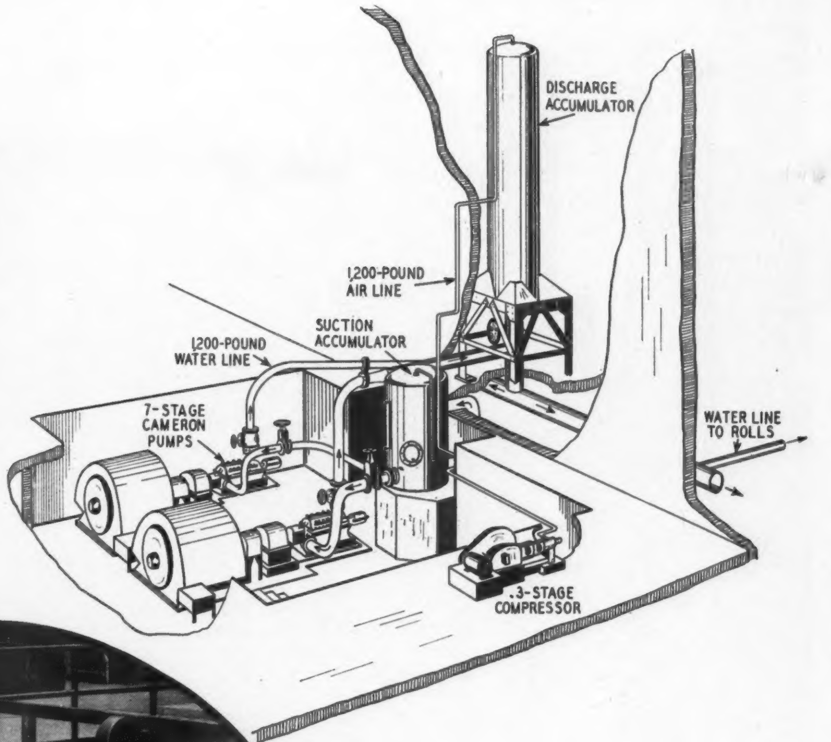
The first continuous strip mill was placed in operation in Ashland, Ohio, in 1924, by the American Rolling Mill Company. Two years later an improved mill of the same type was opened in the Pittsburgh district by the Columbia Steel Company, now a division of the American Rolling Mill Company. It became the prototype of present-day mills. Twenty-six of them have been built in the United States, and others are in course of construction. America has taken many of its steel-making ideas from Europe; but the continuous mill stands to the credit of Yankee steel masters. In fact, at least one such mill is now being manufactured in the United States for erection in England.

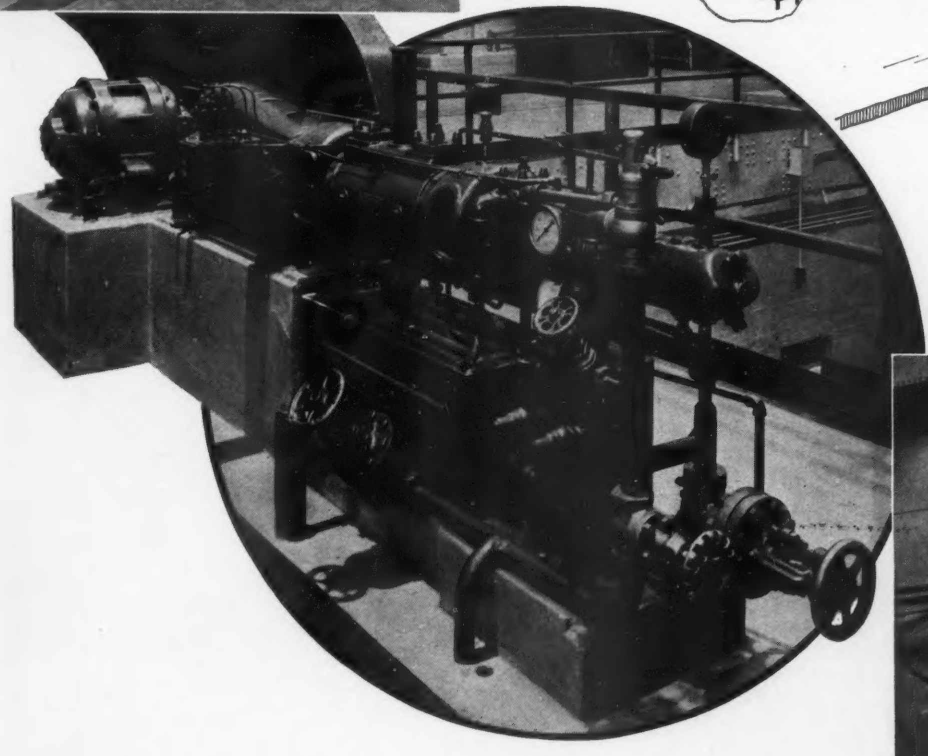
One of the most modern continuous strip mills has recently been placed in operation in Pittsburgh, Pa., by the Jones & Laughlin Steel Corporation, the fourth largest steel producer in the United States. It was constructed at a cost of $25,000,000, and occupies 23 acres of land. The buildings that house it are all under one roof, extend for 2,284 feet along the Monongahela River, and vary from 453 to 510 feet in width. Their construction involved the excavation of 212,000 cubic yards of material and the movement of 400,000 tons of ore that had been stored on the site, as well as the driving of 3,261 pipe piles totaling 88,188 feet in length. These were filled with concrete. The weight of the building materials and of the machinery in the mill is 212,500 tons. There are 4½ miles of sewers, 30 miles of service piping, and 162 miles of electrical conduits in the mill. Ten thousand separate drawings were prepared by the engineering department to guide the erectors. For servicing the machinery and handling products there are 24 overhead traveling cranes ranging in capacity from 10 to 75 tons each. These figures are impressive, indicating as they do the magnitude of the development. Even more interesting is the disclosure by the engineers that the buildings were designed for a life expectancy of but fifteen years, as it is considered likely that this plant will become obsolete within that period and give way to a more modern one.

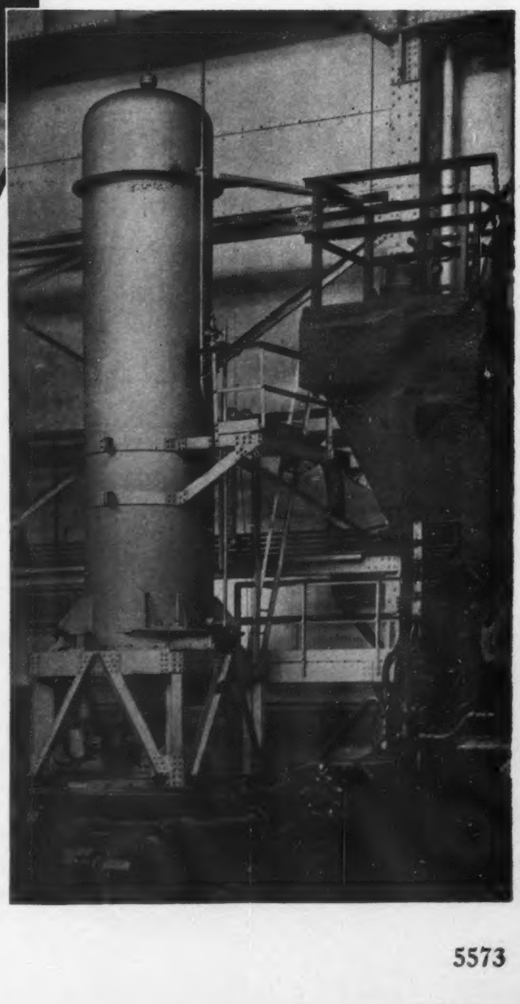
The Jones & Laughlin mill has a monthly capacity of 60,000 tons and is supplying to the trade a complete line of various grades and finishes of hot- and cold-rolled sheets and strip in widths up to 91½ inches. It is also producing light plates of high quality and finish for sale, light-weight hot-rolled strip coils for the company's tin-plate department, and wide skelp for the company's tube mills and for sale.

The mill consists of a hot-rolling division and of a cold-rolling division. The hot-rolling equipment includes ten sets or stands of rolls, each four rolls high, with the rolls in a vertical plane. The first four stands are called the roughing train, and in









MECHANISM OF THE HYDRAULIC DESCALING SYSTEM

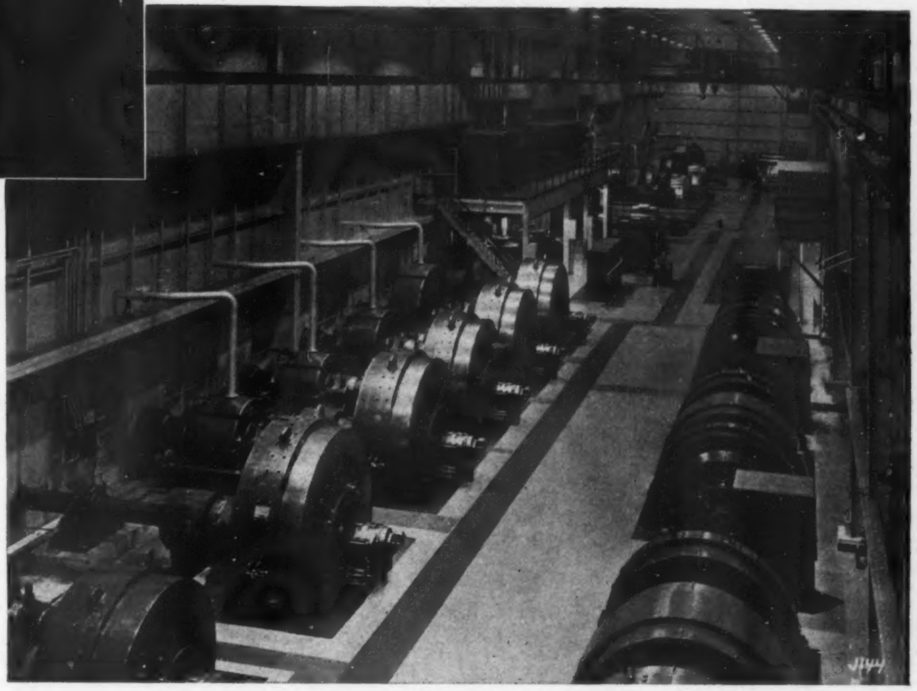
As it comes from the furnace, a slab is coated with scale which must be removed to insure a good rolled product. To accomplish this, it is squeezed lightly between two rolls, and the scale thus loosened is washed off with jets of water, under 1,200 pounds pressure per square inch, that are directed at the slab from above and below. This operation is illustrated at the extreme left. The sketch shows the various phases of this hydraulic system. The water is supplied by two 7-stage, 1,200-gpm. centrifugal pumps, with pressure accumulators acting on both their suction and discharge lines to sustain the pressure and to relieve shocks imposed on the pumps by the repeated, sudden opening and closing of the jets. The suction accumulator is maintained under 30 pounds pressure by compressed air from the plant line and normally contains 2/3 water and 1/3 air. In a similar manner, a 1,200-pound-pressure air line is run into the top of the discharge accumulator from a 3-stage compressor that is equipped with automatic stop-and-start control. The discharge line from the pumps joins that from the accumulator, and the latter supplies water whenever the pump pressure drops. As indicated in the sketch, all this equipment except the discharge accumulator is in a room separate from the hot mill. The picture at the top shows the pumps with the suction accumulator at the right and the discharge line from the pumps passing through the wall behind it. Just above is the 1,200-pound compressor and, at the right, the accumulator in the hot mill that it serves. This accumulator is a steel bottle tested to withstand an internal pressure of 2,000 pounds per square inch.

SHEET PICKLER

Radiating from the top of the vertical plunger are four arms from which are suspended acid-resisting metal crates 100 inches long and 37 inches wide for holding annealed sheets from the hot mill while they are immersed successively in two vats of acid and one of water to remove scale. The crates are alternately raised and lowered in rapid succession to aid the washing process. The plunger is driven with steam and cushioned on the down stroke with compressed air.

THE MILL AT NIGHT

The lights of Pittsburgh form a background for the mill, which is but a short distance from the business section of the city. The brilliant patch of illumination at the left center emanates from Bessemer converters at the Jones & Laughlin works across the Monongahela River.



THE MOTOR ROOM

This 490x65-foot room is totally enclosed, and for a height of 12 feet above the floor its walls are sealed with welded steel plates to exclude water and dirt. The room parallels the hot mill and contains the twelve motors, aggregating 39,000 hp., that drive the rolls. Some of them are shown at the left, with their shafts extending through the wall. Motor-generator sets for furnishing energy to operate cranes, all other motors in the mill, and for lighting and general electrical service also are located here. Among the motors elsewhere in the mill are those that operate the cold mills and five temper mills. These have a total capacity of 13,100 hp. In addition there are 866 motors, ranging from 1½ to 7½ hp. each, that drive the rolls of the run-out tables in the hot mill and plate finishing department. At the far end of the motor room are the air compressors and the hydraulic equipment for operating the slab squeezer and the hot-mill descaling units. To exclude dust, this room is maintained under slight pressure. Filtered and cooled air is circulated for ventilation and to cool the electrical machinery.

passing through them the slab receives its preliminary reduction. Further reduction to the finished hot-rolled thickness is accomplished in the six other stands, which constitute the finishing train. Just ahead of each group of rolls is a scale-breaker—two rolls, one vertically above the other. Each piece being rolled goes through all these rolls in a continuous operation. Among the accessory equipment are heating furnaces, tables, shears, trimmers, levelers, pilers, coilers, annealing furnaces, and other necessary apparatus for finishing material for delivery to the cold-rolling mill or for shipment elsewhere.

The cold-rolling division consists of two mills in both of which the vertical stands of rolls are arranged in tandem, the piece being rolled passing directly from one stand to the next in the line of travel and being reduced in a continuous operation to its finished thickness. One mill is made up of four stands of rolls each four rolls high and will handle sheet or strip up to 54 inches wide: the other mill, which reduces sheets up to 93 inches wide, has three stands of 4-high rolls. Supplementing these mills are three temper mills, for imparting the desired surface hardness and finish to material, and a full complement of finishing equipment, including picklers, heat-treating furnaces, shears, levelers, trimmers, and shipping facilities. There is also a complete department for turning out galvanized sheets.

The entire plant is streamlined, meaning that it has been designed to facilitate the flow of material through it with few breaks in the continuity and with virtually no back-tracking. It is electrically operated; and in the motor room that parallels the hot mill some $8,000,000 worth of equipment is concentrated. Elsewhere in the plant are hundreds of individual motors.

In an article of this length it is impossible to describe the operations in detail, so our purpose shall be to cover the principal ones and to point out some of the numerous uses of compressed air. For the sake of clarity we shall follow a slab of steel through the plant. The slabs are hauled in railroad cars across the Monongahela River from a new 44-inch blooming mill, which was erected to supply the sheet mill with suitable material for making high-quality products.

The slabs are reduced from ingots, and vary in size according to the nature and physical dimensions of the products that are to be made from them. They range from 22½x60x4 inches to 48x188x6 inches and weigh from 3,000 to 9,760 pounds each. The average slab is about 41x87x5 inches and weighs around 5,000 pounds. They are delivered to a 100x650-foot slab yard equipped with two 25-ton overhead cranes and 15-ton auxiliary hoists for handling them. Defects are removed from them either with air-operated chipping hammers or acetylene torches prior to charging them into one of the furnaces.

There are three heating furnaces, each with an inside width of 18 feet and an effective length of 80 feet. Each is divided into a main heating zone and a secondary heating or soaking zone, and will accommodate a double row of slabs up to 7½ feet long or a single row of longer ones. Slabs are elevated to the 112-foot-long charging table at the rear of the furnaces by a magazine feeder. Upon a signal from the head roller, a slab is introduced into a furnace by an electrically operated ram. As it enters, it pushes the entire row of slabs ahead of it, the forward one being discharged at the opposite end.

The main heating zone has six burners above the stock and six below. The rate of heating is varied by controlling the burners. The soaking zone has eight burners, spaced across it and above the stock only. In this the firing rate is held constant. The furnaces are equipped to burn either coke-oven gas or tar. Combustion air at 600° to 800°F. is supplied to the burners from a heating chamber or recuperator underneath the rear of the furnaces. Each furnace will heat 50 tons of cold slabs an hour to rolling temperature. The fuel consumption is estimated to be 1,650,000 Btu's per gross ton of cold steel heated. The slabs travel through the main heating zone supported on water-cooled skids; but in the soaking zone they rest on a solid hearth composed of refractory materials underlain by 6 inches of chrome ore.

Emerging from one of the furnaces, at a temperature of 2,150° to 2,250°F., a slab slides down an incline to a mill approach table made up of closely spaced, motor-driven rollers. These move it to and into the first scale-breaker, consisting of two rolls each 24 inches in diameter and 76 inches long. The slight squeezing action of these rolls cracks loose the scale that has been formed in the furnace, and this is removed at the delivery side of the rolls by hydraulic sprays operating under 1,200 pounds pressure per square inch. There are two rows of these water jets, one above the slab and one below it, spaced on 4¾-inch centers and directed at a slight angle toward the direction from which the slab is advancing. High-pressure water has proved very effective for this descaling service, and it is generally conceded in the steel industry that it is superior to any other method for insuring a high-quality product with accurate gauge and desirable surface finish.

The high-pressure water is supplied by pumps; but, because of the character of the

A SLAB STARTS ITS TRIP

As a ram pushes a cold slab into the rear end of the furnace, 90 feet away, the row within it is moved ahead and the forward slab, shown here, slides out and down an incline to the roller table which will carry it into the series of rolls. Approximately a minute later, having been squeezed ten successive times, it will issue as a red-hot, flattened ribbon several hundred feet long. It starts its journey at a temperature of about 2,250°F. The top-hinged furnace door closes immediately and tightly, preventing cold air from entering.

OPERATING PULPIT

From this station, considerably above the floor, trained operators watch the progress of each slab through the finishing rolls of the hot mill and regulate the speed to secure the best results.

STRIP COILER

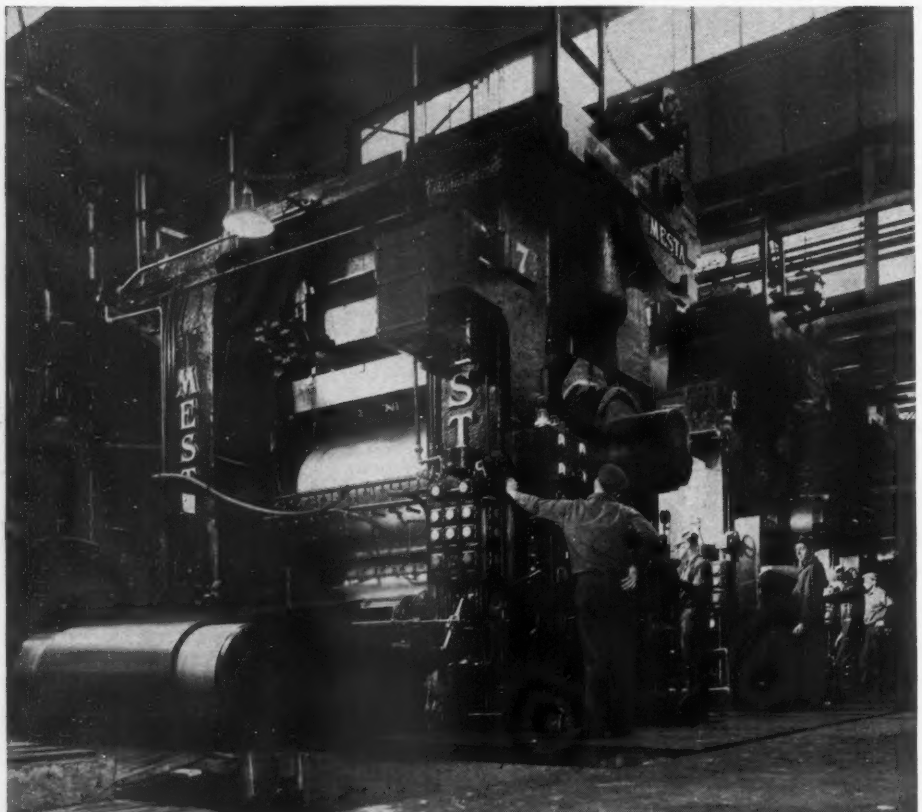
After issuing from the final roll in the hot mill, the ribbon of steel travels 370 feet on the run-out table to either of two coilers, which are used alternately. A gate in the top of the table is opened by an air-operated mechanism and the strip passes down through it and is wound around a mandrel below. When complete, the coil is ejected by an air-driven pusher on to a cradle, as shown in the picture. This is then tilted, again by air, and the up-ended coil is delivered to a chain conveyor which moves it to a roller conveyor under the floor at the left and leading to a storage space. Coiling the strip while it is hot not only makes it easier to handle but also sets up self-annealing, which is beneficial to the grain structure.

service, it is desirable to provide additional means of maintaining the pressure at all times. The slab moves through the sprays rapidly, and it is necessary that the full force and capacity of the jets be made available immediately and be sustained until the slab has passed them, when they are just as suddenly turned off. The alternate turning on and shutting off of the jets so quickly imposes severe shocks on the pumps. To relieve these and to provide better and more economical operation, pressure equalizers are incorporated in the line both ahead of and after the pumps. An accompanying drawing will make clear the relationship between the various elements in the system.

There are two duplicate Cameron HST 7-stage, centrifugal pumps each rated at 1,200 gpm. against 1,200 pounds pressure. Each is driven through speed-increasing gear by a 1,150-hp. motor and operates at 2,100 rpm. These pumps have cast-steel casings and stainless-steel rotating elements. Because of the working conditions, the demand for water may vary within a second or two from 40 to 1,200 gpm. To insure a constant suction pressure of 30 pounds per square inch, a surge tank is interposed in the supply line. This is a 6x10-foot vertical tank in which the desired pressure is maintained on the suction water by a compressed-air line entering it at the top. This air is taken from the plant supply system, being reduced to the pressure required.

The discharge line from the pumps joins a discharge line at the bottom of an accumulator—a vertical steel bottle 5 feet in diameter and 25 feet high, with 3-inch-thick walls, and tested for 2,000 pounds pressure per square inch. The lower two-thirds of this vessel normally contains water, and the upper one-third is charged with air under 1,200 pounds pressure. This air is introduced at the top, and is supplied by an Ingersoll-Rand Class ES, 3-stage compressor that is driven through V-belts from a 25-hp. motor. By means of the accumulator the pressure on the discharge line to the jets is kept constant. Such a system permits the use of smaller pumps, with capacities based on the average instead of the peak demand, and reduces the consumption of power.

From the descaler the slab moves to the first stand of 4-high rolls. This is termed a spreading mill, as it increases the width of the slab while at the same time reducing its thickness. To permit directing the slab into the rolls broadside on instead of endwise, a turntable is located just ahead of the spreading stand. If the finished prod-



93-INCH COLD MILL

The strip of steel, moving from right to left, passes through three stands of rolls and is then recoiled. Just above the reel at the far side of the sheet may be seen a flying micrometer that measures the thickness or gauge of the steel. This measurement appears on an indicator for the guidance of the mill operators.

uct is to be wider than 48 inches, the slab is turned 90°, otherwise it continues end foremost. Following the roll stand is another turntable where the slab, if it has been turned, is returned to its original position before proceeding to the next operation.

The 4-high roll stands, of which the spreading stand is an example, each consist of two working rolls and of two backing-up rolls, one above and one below the working rolls. All have a face length of 96 inches. The working rolls are relatively small, those on the spreading stand being 38 inches in diameter. The backing-up rolls are 51 inches in diameter and weigh 55 tons each. Their function is to apply the tremendous pressure that is required to reduce the steel and to prevent the working rolls from springing by reason of the heat of the slab and the resistance offered by it.

From the spreader the slab passes through a hydraulically driven squeezer where it is leveled and its sides are trued, removing the unevenness of the edges and surfaces. It then moves to the second roughing stand which has vertical edging rolls on the entry side that maintain the width of the slab as established in the squeezer. Beyond No. 2 roughing stand the length of the roller tables between each pair of stands increases, being so proportioned that the lengthening steel will be engaged in only one set of rolls at a time. Finally, when the slab emerges from the fourth and last roughing stand, its thickness has been reduced by approximately 85 per cent and its length has been extended accordingly. The width is kept constant by the vertical edge rolls in each stand.

Between the roughing and finishing trains is a roller table 100 feet long. On this the steel moves rather slowly, and as it does its temperature is checked by a recording and indicating pyrometer located about 10 feet above it. The temperature is registered on a dial at the operating station or pulpit; and if it is above the desired point, the sheet is moved backward and forward on the table until it has cooled sufficiently for satisfactory rolling.

After receiving another descaling squeeze and scour, the slab passes successively through the six stands of finishing rolls. These are spaced 18 feet apart, and the rapidly elongating strip is engaged between all their reducing rolls at the same time. As the slab is rolled thinner, it grows progressively longer; and to compensate for this, the six stands of rolls operate at varying speeds so as to increase the rate of rolling as the steel moves forward. Accordingly, as it emerges from the final rolls, the strip may be traveling at anywhere from 1,037 to 2,074 feet a minute, depending upon the thickness or gauge of the product.

Rolled material is delivered to a long line of individually motored rollers which make up what is known as the mill run-out table. At a distance of 11 feet 9 inches from the last finishing rolls is a rotary cutting device, called a flying shear, which is driven by twin, 150-hp. motors controlled hydraulically from the last roll stand. This shear will cut strip up to 91½ inches wide and 5/16-inch thick into equal sections from 11 to 22 feet long. Its action is so closely synchronized with that of the roll stand which controls it that the material produced does not vary more than ¼ inch in length.

Returning momentarily to the rolling operations, we can point out several uses of compressed air. The quick-acting valves that control the water jets of the descaling sprays may be operated manually or may be opened and closed automatically by a flag on the rolls which actuates a pneumatic device. If the scale on the slab is extremely heavy, jets of high-pressure air may be directed against all sides of it immediately after it has passed through the water spray.

For the backing-up rolls there are three separate Bowser pressure-oiling systems, each with its own storage tank, automatic pumps, filters, centrifuge, and cooler, as well as a surge tank in which compressed air maintains a uniform pressure. One system has a storage capacity of 16,000 gallons and supplies oil to the bearings of the rolls at a rate of 350 gpm. The second, likewise with a circulating capacity of 350 gpm. but with a storage capacity of 7,500 gallons, lubricates the reduction gears through which the rolls are driven and their bearings. The third, of 225-gpm. circulating capacity and 8,000-gallon storage capacity, serves the pinion bearings. Immediately following the flying shear is a quenching spray which is controlled pneumatically.

The surface quality of the hot-rolled product depends largely upon the surface of the finishing rolls through which it passes. These rolls are therefore changed after from two to eight hours of service. Although they weigh 10 tons each, they are handled rapidly by a special rig borne by one of the overhead cranes. Used rolls are taken to the roll shop, where they are accurately reground and given a high surface finish. The rolls are fine examples of the steelmaker's art, being absolutely cylindrical and free from flaws. Each roll costs approximately $5,000. The contact rolls in the roughing stands and the backing-up rolls in all stands are changed less frequently.

The run-out table to which the hot-rolled strip is delivered is more than 500 feet long. The disposition of the material after it reaches this table varies with its character. If it is plate stock, it is transferred from there to a secondary and parallel table by lugs that rise from endless chains. It is then smoothed, leveled, and cut into lengths, of from 3 to 50 feet each, which are stacked while still hot to undergo self-annealing while cooling. When they are cold, which may be as long as 24 hours later, they are finished in accordance with the

specifications of the respective customers.

The difference between plates and sheets is principally a matter of thickness. Plates produced in this mill range from ¾ to 3/16 inch thick, while sheets may be rolled as light as No.10 gauge in widths to 91½ inches and as light as No.19 gauge (7/160 inch) in widths to 46 inches. When sheets are being rolled, the steel is cut into multiples of the finished length by the flying shear unless, of course, the order calls for strip which is wound into coils. The sections are then delivered by the run-out table to either of two pilers, on which the end stops are air-operated. There they are stacked, and the stacks are picked up by a special rack borne by an overhead crane and delivered to a cooling bay. Sheets of light gauge are piled while still hot so that they will retain their heat for self-annealing.

Further treatment of the sheets after they have cooled varies with the ultimate use to which they are to be put. If the order specifies normalized material, they are heated in a 108-foot-long normalizing furnace, being raised to a temperature of about 1,750°F. in the fifteen minutes it takes them to pass through the heating zone. By introducing steam, a blue protective oxide is formed on the steel—the process then being called blue annealing. Upon cooling, the sheets may go to a pickling unit for removal of surface scale. The operations that take place there are described in connection with one of the accompanying illustrations. Leaving the pickler, they are taken to a scrubber and drier where, after passing between rotary brushes and rubber wringer rolls, they are exposed to a hot air blast from a motor-driven blower. This combination of treatments removes all traces of acid acquired in the pickler. Next the sheets go through a roller leveler, and as a final treatment they are given a light rolling or "skin pass" in a 2-high temper mill. The amount of reduction or draft is regulated, in accordance with the customer's specifications, to produce a sheet having the exact degree of ductility or stiffness desired. This rolling also gives the material a bright, smooth finish.

Much of the product of the hot mill is strip that is designed for further treatment in cold form. It leaves the last roll stand in the shape of a long ribbon and travels on the run-out table, at speeds up to 1,700 feet a minute, a distance of 370 feet to two coilers which wind it for convenience in handling. Owing to the fact that they produce from 75 to 90 coils an hour, it is necessary that all their moving parts work at high speeds. For this reason, the entry gates, internal guides, water valves, extractor, and transfer buggies are all air-operated.

As an accompanying illustration shows, the coilers are located in a pit beneath the run-out table. There the strip is wound on a mandrel and the finished coil is ejected, tied with wire, and moved by a chain conveyor to a roller conveyor leading to the coil-storage department. This roller conveyor as well as others have air brakes and air stops some of which are controlled manually and others automatically. In the latter case, a flag tripping device on the table actuates an air cylinder that slows up or stops from six to eight rollers, thereby retarding or halting the progress of the coil.

ANNEALING FURNACES

To give steel sheets the deep-drawing qualities that are essential in converting them into various shapes, all cold-rolled material is annealed to relieve internal strains resulting from rolling. In the form of either coils or sheets, the stock is covered with inverted steel boxes and heated in a controlled temperature. There are twenty furnaces in this line, each large enough to house two boxes. The picture shows one of them being charged by a special traveling mechanism that is known among the mill men as the "China Clipper." During annealing and subsequent cooling on the beds in the foreground, the boxes are filled with inert gas to prevent oxidation.

After cooling in storage, the coils are pickled for removal of scale in either of two continuous lines. At the head of each is an uncoiler, followed by a scale-cracking machine which uses compressed air to blow off the loosened oxides. The ends of the strip are sheared square and, to form a continuous line, are either lapped and stitched together or butted and arc-welded. The push-up unit on the electric welder is operated by a combination of compressed air and cam mechanism. Each pickling line is 600 feet long and contains four acid tanks and two wash tanks through which the material moves at speeds up to 168 feet a minute. All tanks are of steel construction and are lined first with rubber and then acidproof brick. The tanks are covered, and fumes are exhausted outdoors by fans. As it emerges from the pickling line, the strip is dried by hot air, oiled, sheared into its original lengths, and recoiled. All coils are weighed before and after pickling to ascertain the loss in the process.

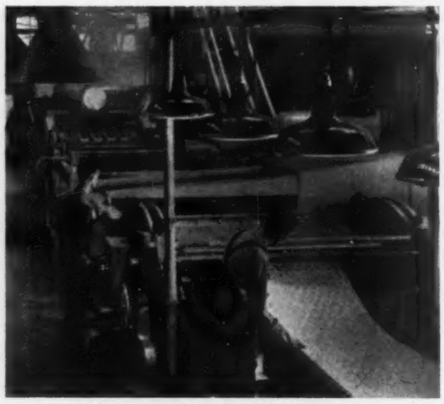
At this point the coiled strip is of two general classes. According to its ultimate use, some of it goes to the company's Aliquippa works for further processing into tin plate while the remainder, with which we are concerned here, goes through the cold mill and is to a large extent employed in the automotive industry. The latter material is fed cold from the pickled and oiled coil through one of the cold mills, the equipment used depending upon the width of the strip and the specifications of the final product. After passing through the mill, it is side-trimmed, roller-leveled, and then recoiled, or cut into lengths to meet the customer's requirements.

A reduction of 60 per cent in the thickness of the metal is customary for full cold rolling. The speed of rolling ranges from 463 to 1,150 feet a minute in the 4-stand,

54-inch-wide mill and from 388 to 766 feet a minute in the 3-stand, 93-inch-wide mill. There are air-operated controls on all entry guide boxes on these mills and on the cleaning and cooling spray systems serving practically all the rolls. The tension reels on which strip is recoiled after rolling have air-operated strippers, and an air-actuated retriever cylinder gives the belt wrapper the necessary tension. Lubrication of the backing-up rolls of the cold mills is effected by equipment similar to that used in the hot mills, save that there are two independent systems instead of three. Air-pressure surge tanks perform the same function that was described in connection with the lubrication of the hot mill. The two tandem mills have a nominal capacity of 30,000 tons a month.

Much of the product of the cold mill is formed or drawn into various shapes such as automobile tops, and must have the right physical properties to be readily worked. Accordingly, after the steel is cold-rolled it is carefully annealed to relieve all internal strains. This can be done with the material in coil or in sheet form. In either case, it is placed on a large steel base and covered with an inverted steel box the bottom edges of which are sealed with sand. The interior is then filled with an inert gas, a combustion product, that prevents oxidation of the steel during annealing. These boxes are run into the furnaces by a special machine that travels on a track in front of the line of furnaces. Mounted on it is a small compressor which supplies compressed air to operate the locking dogs on the racks by means of which the boxes are raised in the furnaces for withdrawal and lowered on to cooling beds outside.

There are three skin-pass or temper mills in which box-annealed material is given a final rolling to improve its surface and to give it the stiffness that it must have to undergo subsequent manufacturing operations by the customer. Reductions of from 1 to 3 per cent in thickness are made



GALVANIZING EQUIPMENT

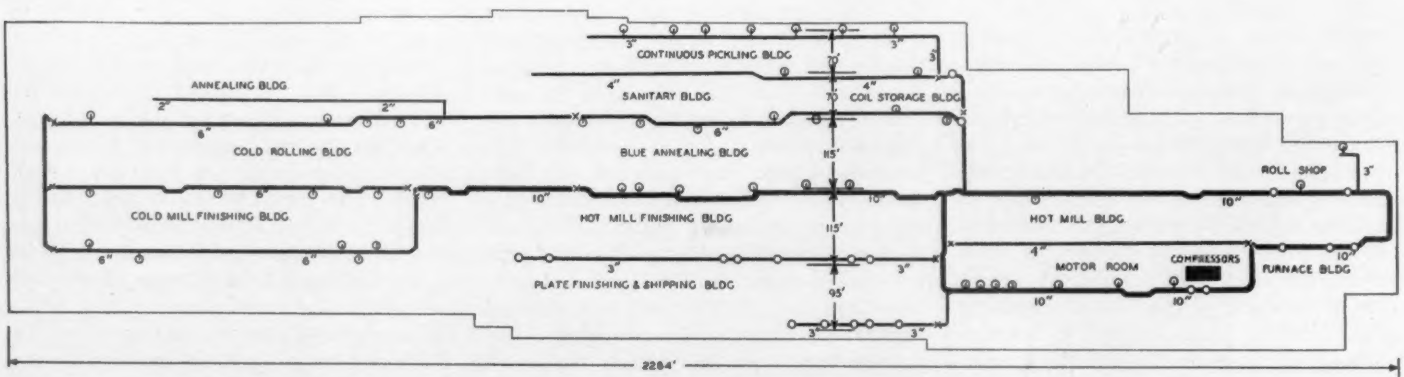
in these mills, two of which are four rolls high and the third two rolls high. If the finished product is eventually to be painted or enameled, then it is necessary to impart to the surface of the steel a dull, slightly roughened surface that will form a good bond with the coating to be applied. This is accomplished by utilizing rolls that have been sand-blasted. This sand-blasting is done in a special Pangborn machine in which the nozzle is directed at the roll as it is slowly revolved and is moved along the face of the roll until its full width has been treated. Two sizes of steel grit or abrasive are used for this work.

Throughout the mill are what are known as cut-up units in which the coiled material is cut into sheets, or sheets are further reduced in size or squared up. Auxiliaries on these units are operated by either hydraulic or pneumatic mechanisms. For light operations and quick action, air is favored. Brakes, stops, clutch controls, and devices for holding the work in place or for ejecting it are usually air-actuated.

At various stages in the processing of cold sheets, they are passed through roller-levelers which flatten any elevations and iron out any bends that result from handling. This treatment produces a sufficiently flat sheet for most purposes, but specifications sometimes call for material of perfect flatness. To obtain this, the sheet is run through a stretcher-leveler, where it is gripped at both ends by jaws attached to pistons through which a hydraulic pull is exerted and the sheet is stretched taut. All material is rigidly inspected before shipment, an inspector being stationed at the delivery end of each temper mill. He stamps acceptable pieces: others are cast aside. Care is also exercised in wrapping material and in packing it in cars to prevent damage in transit and to facilitate its unloading by the customer.

Galvanized sheets are being used more extensively every year, being particularly favored on farms where fire, wind, and weather take from less resistant materials an annual toll estimated at $400,000,000. The new Jones & Laughlin mill includes a complete galvanizing department for turning out sheets of No.10 (9/64 inch) to No.31 gauge (7/640 inch) in widths up to 60 inches and lengths up to 180 inches. Sheets to be galvanized are cleaned in an oscillating-type pickler, consisting of two acid tanks and of four rinse tanks. The temperature in these tanks is automatically regulated by air-actuated steam control valves. After being dried, the sheets are run through a bath of molten zinc. The speed of passage can be varied from 10 to 160 feet a minute, and is controlled so as to obtain the desired thickness of coating. Too heavy a film tends to flake off later in handling. Magnetic rollers convey the sheets to a cooling conveyor on which they pass under blasts of air. They are then leveled, washed, dried, and leveled again. Depending upon their ultimate application, they may be shipped in flat form or may be corrugated or given other special treatments.

In addition to its uses in the mill processing work, compressed air is extensively employed for operating pneumatic tools, paving breakers, etc., in plant maintenance work. During the construction of the mill, all air, water, and steam piping was tested with compressed air.

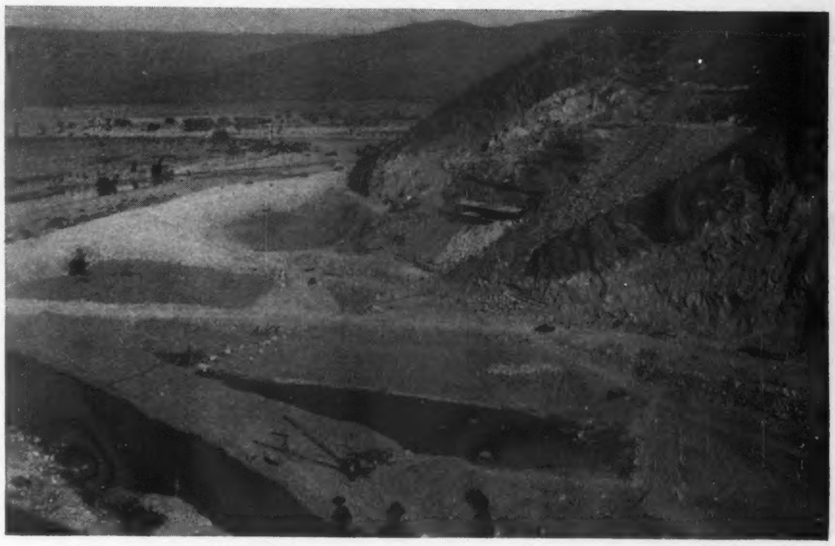


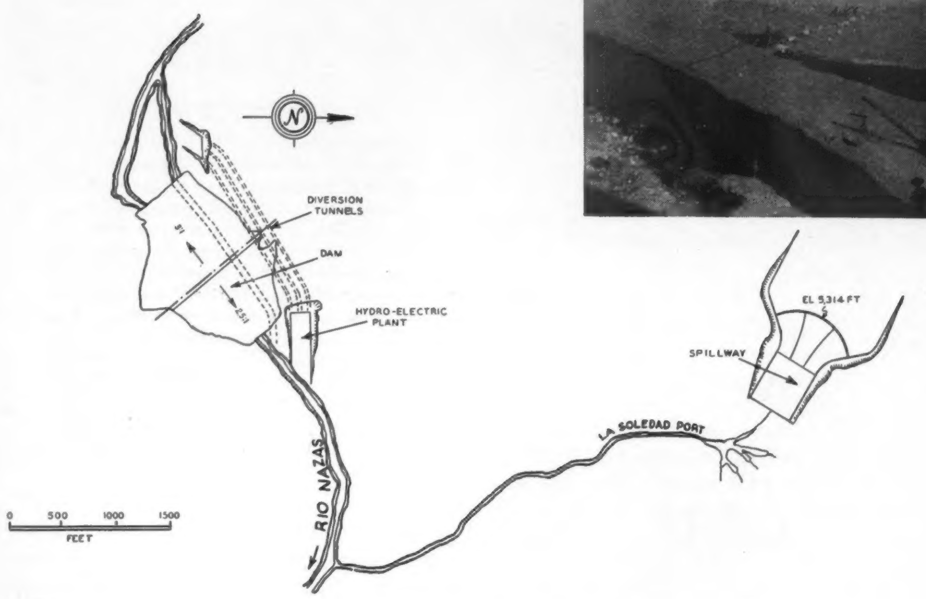
COMPRESSED-AIR DISTRIBUTION SYSTEM

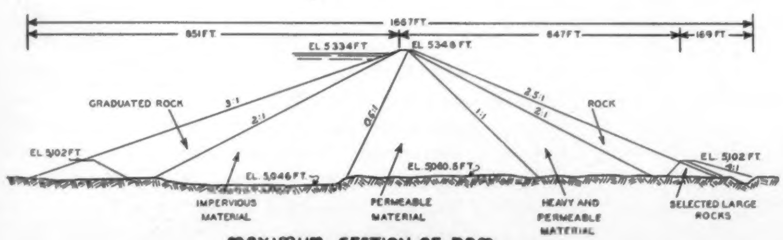
The main air lines with connections indicated by circles and valves by crosses. This is an all-welded line, and most of it is carried overhead along the rows of building columns. Laying of this piping kept pace with building construction so that air would be available for operating tools, a necessary service, as evidenced by the fact that 900,000 rivets were driven. The plant consists of two 2-stage compressors, each of 3,205 cfm. piston displacement and driven by a 600-hp. synchronous motor. The discharge pressure is 115 pounds at the compressor and from 98 to 100 pounds at the ends of the lines. This plant also supplies air to the Eliza Works, which is to the right of the strip mill. Including this extension, the air lines serve an area approximately 3,000 feet long. In the strip mill, alone, there is more than half a mile of 10-inch mains.

Three Large Dams in Mexico

Juan J. Ortega







MAXIMUM SECTION OF DAM

EL PALMITO DAM

This structure on the Nazas River and in the State of Durango will impound sufficient water to irrigate 400,000 acres in the Laguna region in the State of Coahuila. In addition, it will make possible the generation of a considerable block of electric power, some of which will be used for pumping irrigating water to higher lands. There will also be a surplus for utilization in nearby mining camps. El Palmito Dam will have a maximum height of 295 feet. A natural gap, known as La Soledad Port and situated about 1.2 miles from the dam, provides an excellent location for the spillway, and its presence will save several hundred thousand dollars in the cost of construction. The picture just above shows the beginning of the three diversion tunnels that are being driven to by-pass the river during the erection of the dam. The upper one shows work in progress on a canal being excavated on the left side of the Nazas below the dam site.

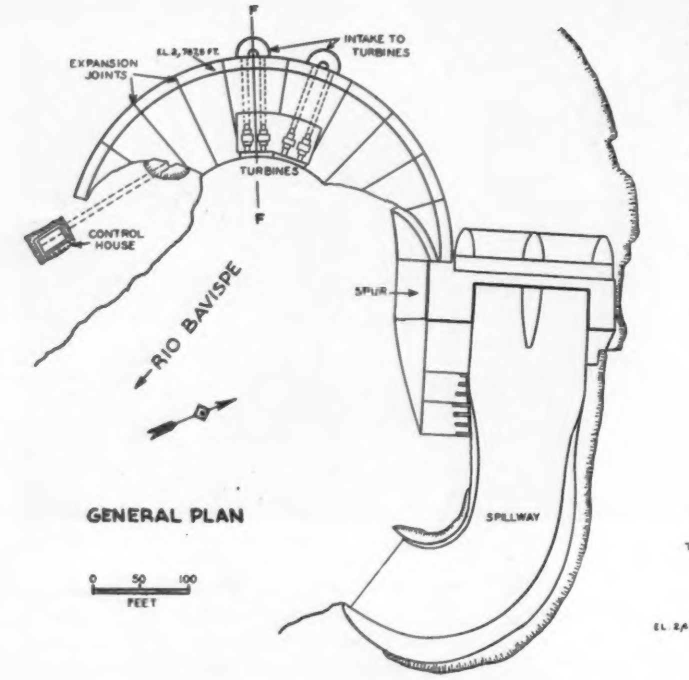
THE Republic of Mexico, by reason of its geographical location, has a variety of climatic conditions. It contains large semi-arid areas that are crossed by streams that are small during the dry season but swell to great size during the rainy season. Along almost all these streams, which at times carry large volumes of water, there are appropriate reservoir sites which can be utilized to establish irrigation systems by the construction of dams.

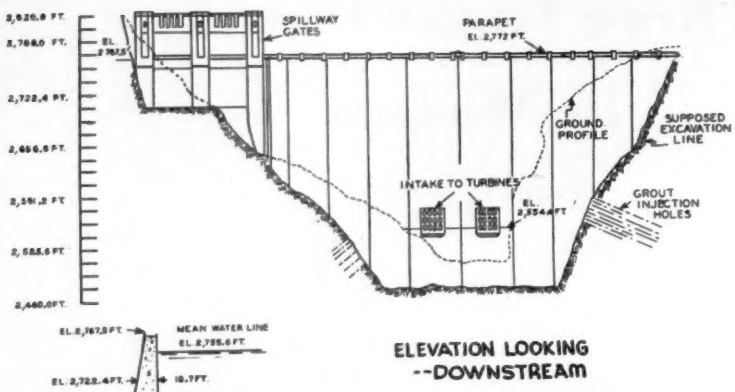
Conscious of the pressing need of such irrigation works, the federal government in 1926 created the National Irrigation Commission to plan and to carry out feasible projects in various sections of the country. During the ensuing 10-year period there was expended for these purposes more than $100,000,000, Mexican currency. Owing to the recognized importance of the improvements, the government presided over by Gen. Lazaro Cardenas has recently intensified the building program by approving a 4-year schedule of work that involves the expenditure of $150,000,000, Mexican currency.

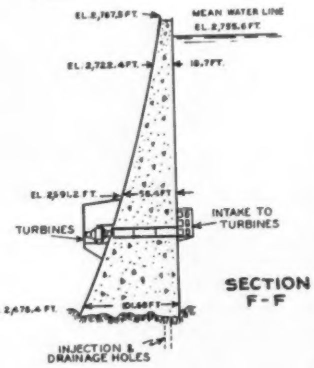
Besides a large number of smaller undertakings, construction has been initiated on three large dams: La Angostura, in the State of Sonora; El Palmito, in the State of Durango; and El Azucar, in the State of Tamaulipas. They are features of the Yaqui, Nazas, and San Juan projects, respectively. This article is designed to present a general description of each of these projects, with particular reference to the dams, on all of which work is actively underway.

The Yaqui Project

THE Yaqui Project is in the State of Sonora, in the drainage area of the Yaqui River and its various tributaries. The irrigable lands are in the southern part of the state and are divided into two zones: one of about 750,000 acres in the southern section of the valley, and the other of some 250,000 acres farther north. All lie between the settlement of Limones and the outlet of the Yaqui into the Gulf of







LA ANGOSTURA DAM

This structure on the Bavispe River and in the State of Sonora will provide storage for sufficient water to irrigate 310,000 acres of land and to generate electricity. It is the first of a series of dams that will bring the Yaqui River system under complete control. La Angostura Dam will be a concrete arch that will rise 328 feet above bedrock in a narrow canyon. The spillway will be situated at one side and will be regulated by two 50x50-foot gates. Water for irrigation downstream will pass through the dam, as will that needed for power generation. During the construction period the river will be diverted through a tunnel in one of the canyon walls.

California. The area immediately adjacent to the gulf is worthless for agriculture because it is impregnated with saltpeter. Using the water that comes down the river during freshets, about 100,000 acres are now being irrigated. Development of the storage system will provide water for 650,000 additional acres and will also improve irrigation in the area now receiving water.

The Yaqui Valley is generally one of low altitude, and is visited by light frosts only in the middle of winter, with warm weather prevailing throughout the summer. The climate is, accordingly, favorable to agricultural development. Transportation facilities for farm products are provided by the Southern Pacific Railroad of Mexico, which crosses the agricultural zone. There are also some roads which are passable in the dry season, but not in the rainy season. Two ports, both served by the railroad, are available for exportation of the products. These are Guaymas, north of the Yaqui Valley, and Yavaros, south of it. The principal crops now grown are corn, beans, chick-peas, wheat, cotton, peas, tomatoes, cucumbers, lettuce, rice, and alfalfa. These are marketed not only locally but also in other parts of the republic, and there is considerable exportation to Spain, Cuba, the United States, and Canada. The settlers have extensive agricultural and commercial experience.

The existing irrigation works, which were constructed many years ago, consist of a diversion dam at Los Hornos, and of a main canal which extends for 44 miles along the northern side of the valley and which has numerous branches. These serve to divert and to distribute flood waters, which at times attain a volume of 350,000 second-feet. During low-water periods, however, the flow sometimes drops to as little as 175 second-feet.

The principal tributary of the Yaqui River is the Aros, which is fed, in turn, by the Bavispe and the Moctezuma. All these streams derive their waters from the elevated regions of the Sierra Madre, which receives abundant precipitation. This is largely seasonal, however, and, as a result, the regimen of the Yaqui River is one of great fluctuation. Seventy per cent of its annual flow courses down its channel during the months of July, August, and September. The 20-year average of the annual discharge at the point where the stream leaves the mountains is 3,240,000 acre-feet. The maximum recorded discharge was 8,600,000 acre-feet in 1914, and the minimum was 450,000 acre-feet in 1917.

In the Yaqui River system there are several basins that offer potential reservoir sites. Among these the main ones are: the La Angostura on the Bavispe River; the Aguila, some miles below the confluence of the Moctezuma, the Aros and the Yaqui; the Camellon on the Papigochic River; and the Calaboza, on the Aros River. Construction of dams at all these locations will make possible complete utilization of the waters of the Yaqui. This development will be done by stages, the first of which will be the building of La Angostura Dam. This will provide storage sufficient to irrigate 310,000 acres of land situated on both sides of the river. In addition to the benefits it will bestow through irrigation, the ultimate plan will make practicable the generation of considerable hydro-electric power. The construction of the dams mentioned will provide heads of from 130 to 165 feet, and will permit the installation of plants ranging in capacity from 8,000 to 10,000 kw.

After La Angostura Dam and its auxiliary works have been completed, it is proposed to build Camellon Dam, which will impound water enough to irrigate 125,000 acres. Following that will come the Aguila Dam, which will bring 475,000 more acres under irrigation. Hydro-electric plants in connection with the two structures last mentioned will develop 28,000 kw. of electrical energy. The last stage calls for the connecting of all the hydro-electric stations and the utilization of the power for pumping available water to a higher-level canal system which will serve to put still more land under cultivation. It may, possibly, include additional dams.

The design that is being followed in the construction of La Angostura Dam was chosen after a careful and detailed study of various suitable forms. It will consist of a concrete arch 328 feet high that will be keyed directly to the left abutment wall, and of a gravity section at the other end tying it to the right slope. The spillway will be located in this gravity spur, and will be regulated by two square gates measuring 50 feet a side. While building is in progress, the river flow will be diverted through a tunnel driven in one of the canyon walls. The outlet for the release of irrigating water will pass through the concrete arch and will be controlled by needle valves 60 inches in diameter. The work will require more than 160,000 cubic yards of concrete specifying principally low-heat cement manufactured near Hermosillo, Sonora. A system of piping will be incorporated in the arch for the circulation of water to expedite the cooling of the concrete.

The Nazas Project

THE Nazas River drains a large part of the State of Durango, in which it and its tributaries rise. It flows eastward into the State of Coahuila, where it empties in-

to the Mayran Lagoon. The region around this lagoon contains approximately 750,000 acres of fertile plains that can be irrigated. The climate is variable, with seasonal extremes, but the area is healthful. Its population is more than 180,000, the principal centers being Torreon, Gomez Palacio, Lerdo, and San Pedro. Transportation facilities are good, as the main railroad from Mexico City northward to Juarez passes through it, and there are also branch lines connecting Torreon with Saltillo, Monterrey, Durango, and other points. The highways are for the most part in good condition.

The chief crop at present is cotton. For its cultivation dependence for water must now be placed on freshets, and these do not come with regularity owing to the variable regimen of the Nazas. There are in existence extensive irrigation works such as canals built by private initiative. There are also more than 700 wells from which ground water is drawn for irrigation during the periods when the river flow will not meet requirements.

The region is completely colonized; but the prosperity of the people is subject to the irregularity of the water supply and likewise to the fluctuation in the price of cotton. By diversifying the crops—which can be done if an ample and regular supply of water is assured—it is certain that greater economic stability can be realized. The cotton now produced supplies several textile mills in Mexico, and some of it is also exported.

Studies looking towards the construction of dams on the Nazas River have been conducted for 40 years; but the great cost involved has deferred execution of the plans. The most recent investigations led to the selection of El Palmito as the best dam site. The dam will impound enough water to irrigate 400,000 acres, thereby eliminating poor crops caused by a shortage of water and improving the whole economic life of the region. Incidental use can also be made of the water by generating electricity.

Rainfall averages 27 inches a year in the mountainous areas where the Nazas rises, as compared with 12 inches in the Laguna region which is to be irrigated. In exceptionally wet years the flow of the river sometimes reaches a volume of 162,000 second-feet, while in unusually dry ones it falls to as low as 1,750 second-feet. The annual run-off has varied from a maximum of 2,120,000,000 acre-feet to a minimum of 260,000 acre-feet. The average is insufficient to supply water to all the first-quality lands, in fact, even with the river brought under control and all available supplemental water drawn from wells there will still be an appreciable acreage that cannot be irrigated.

The hydro-electric plant will be constructed downstream from the dam. Most of the energy developed there will be used for pumping water to 75,000 acres of higher-lying choice land. There will be a surplus of 20,000 kw. a year that can be used to good advantage in the nearby mining districts of Sta. Maria del Oro, Guanacevi, and Inde.

El Palmito Dam will be built of a graduated mixture of rock, gravel, and earth, and will have a maximum height of 295 feet. Three diversion tunnels are being driven to carry the river water around the dam site during the construction period. Upon completion of the work two of these will serve as conduits to supply water to the power house, while the other will be used as an outlet for irrigating water and will be provided with needle-valve control at its discharge end. The spillway will be built in the La Soledad Port, situated at a distance of 1.2 miles from the dam itself. It will have a capacity of 280,000 second-feet.

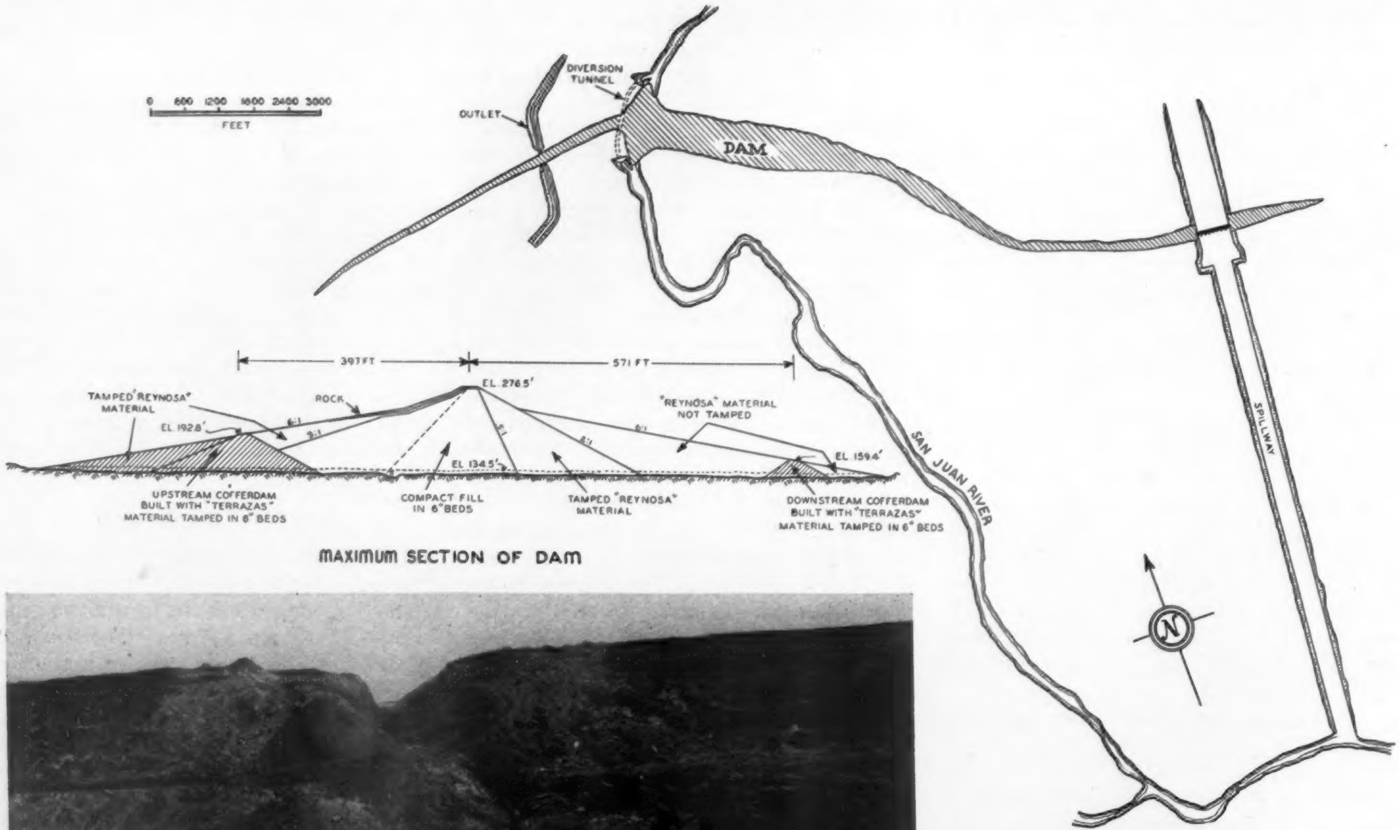
The San Juan Project

IN THE northeastern part of Mexico, the Santa Catarina and Pilon rivers flow into the San Juan which, in turn, enters the Bravo (Rio Grande) River. The basin of the San Juan and its tributaries comprises an area of some 13,500 square miles and lies in the states of Tamaulipas, Coahuila, and Nuevo Leon. It is divided into three zones made up of plains or level regions with an intermediate mountainous section.

The region experiences the extremes of cold winters and warm summers, with a rainy season that extends from May to October. Cyclones which have their origin over the Gulf of Mexico visit it and, upon

SITE OF LA ANGOSTURA DAM

As the view at the right shows, the river has already been diverted, and the work of excavating for the dam foundation and abutments has been started. A section of the construction camp and some of the structures that have been erected to facilitate the work are pictured below. The towers are for the support of a cableway that will be used in placing the concrete in the dam.



MAXIMUM SECTION OF DAM

EL AZUCAR DAM

This will be an earth-fill structure more than 19,000 feet long and spanning a wide valley. It will have an extreme height of 150 feet above the streambed. As the sectional drawing indicates, two cofferdams that will keep the water from the dam site during excavating will be absorbed in the finished structure. Because the flow of the San Juan River is subject to violent seasonal fluctuations, it will be necessary to build most of the dam during the 8-month period between rainy seasons. The photograph shows excavating for the dam abutment in progress on the right side of the San Juan. Besides storing water for the irrigation of 150,000 acres of land just south of the United States border, this structure will be of great benefit in regulating the flow of that highly erratic stream.

passing over the land, cause very heavy rains. Vegetation, in general, is sparse; but where a regular water supply is available it is abundant.

The principal centers of population are Monterrey, Matamoros, Reynosa, Montemorelos, and Cadereyta. The region is crossed by a railroad, linking Monterrey and Matamoros, and by a highway connecting Matamoros with Mazatlan. Cotton is the chief crop, with corn less important, and cattle-raising has been developed to some extent. Save for the cotton, which is exported to the United States, all the farm products are consumed locally. Colonization is considered feasible if a sustained water supply is provided.

Precipitation occurs mostly in the mountainous zone, where it is three times as great as in the lower areas. Whenever a prolonged rainy season has been followed by a cyclone, floods have been experienced. The most remarkable of these were in 1909 and 1932. In former years, the river flow has risen to a volume of 350,000 second-feet. The average annual run-off at the site selected for El Azucar Dam is 1,200,000 acre-feet, and in some years it has reached 1,600,000 acre-feet.

There are several potential reservoir sites, of which the one chosen has the largest capacity and the best location with respect to collecting and distributing water to the irrigable lands. El Azucar Dam will make it possible to irrigate 150,000 acres east of the San Juan River and south of the Bravo.

Another important benefit of the dam will be that of regulating the flow of the San Juan. The dam will be constructed of earth, which will be deposited in layers and consolidated with sheep's-foot rollers. It will have a total length of 19,000 feet and there will be an additional dike 4,200 feet long. Its maximum height above the stream bed will be 150 feet.

Because of the characteristics of the river flow, it will be necessary to build the dam in its entirety during the 8-month period between rainy seasons. Two cofferdams will be constructed—one above and one below the dam site—and the river will be diverted through a tunnel while work is in progress. Owing to the great volume of water that the stream sometimes carries, the provision of adequate spillway facilities is of the utmost importance. Accordingly, there will be installed nine 50x50-foot flood gates capable of passing an aggregate of 740,000 second-feet of water. The outlet works for releasing irrigating water will consist of a tower with four caterpillar flood gates in a tunnel 16½ feet in diameter. They will have a capacity of 2,100 second-feet.

It is impossible, in an article of this length, to discuss details of the design of the various dams and to describe the methods of construction that are being followed. These considerations will be taken up in subsequent articles.

All the work included in this program, which is certain to exert an important influence on the future of Mexico, is being directed by Engineer Francisco Vazquez del Mercado, executive member of the National Irrigation Commission.

Remarkable Properties of Gold Alloys

"TODAY we make gold-alloy wires for clasps and other dental purposes that develop tensile strengths of more than 200,000 pounds per square inch—more than double the strength of ordinary structural steel. Their remarkable toughness and resiliency—they are about twice as flexible as steel—make them less harsh in their action on clasped teeth than steel or other base metals. Furthermore, these wires are capable of being hardened or softened at will by proper heat treatments, so that they can be softened for easy and accurate forming and shaping, and then restored to full strength."

This quotation is from an article by H. C. Ney in the *Executives Service Bulletin* of the Metropolitan Life Insurance Company. Mr. Ney is president of a Hartford, Conn., company that is the largest dental-gold manufacturer in the world. Through its research department this concern has been able to develop alloys which, if they were less expensive, would replace steel for many applications.

Until about twenty years ago, silver and copper were the only metals used for alloying gold for dentists. The resultant alloys did not tarnish and were virtually indestructible; but they were too soft for making the tough, resilient wire needed for thin spring castings. The new alloys were developed by using platinum, palladium, and small amounts of other elements. Their remarkable properties have led to their adoption for many purposes other than dentistry, and the company now produces them in 200 distinct compositions, each of which is designed to meet a specific need.

Concurrent with the improvement in gold alloys has come a better technique of working them. The process of casting restorations of teeth in gold was introduced about 30 years ago, the casting mold being made from a wax model. The known possibilities of the process could not be realized at first because of defects in the technique and in the available materials. Continued research has developed alloys of the right strength and hardness for each of the different types of restorations and has brought about better casting methods. As a result, dental technicians are now producing castings ranging from an inlay for filling the tiniest cavity in a single tooth to the most complicated partial and full dentures for replacing any number of or all the natural teeth. Some of these castings are so intricate that the very thought of them would give the foundryman a headache, yet they are being turned out clean and sound. Furthermore, in dimensional accuracy, smoothness of surface, and sharpness of detail, they compare favorably with industrial die castings.

Not infrequently nowadays an industrial engineer learns something of value concerning the strength of materials from his dentist.

VIEWS OF STRUCTURE

The recently completed Monument to the Revolution adds another beautiful edifice to the many that already exist in Mexico City. It has been created after four years of work on what was originally planned to be a legislative hall. In the foreground is an Ingersoll-Rand portable compressor furnishing power for sand-blasting one of the eighteen pillars that dot the plaza surrounding the monument. This work was done by Julio Jeffrey, contractor of Mexico City.

Imposing Mexican Monument Finished

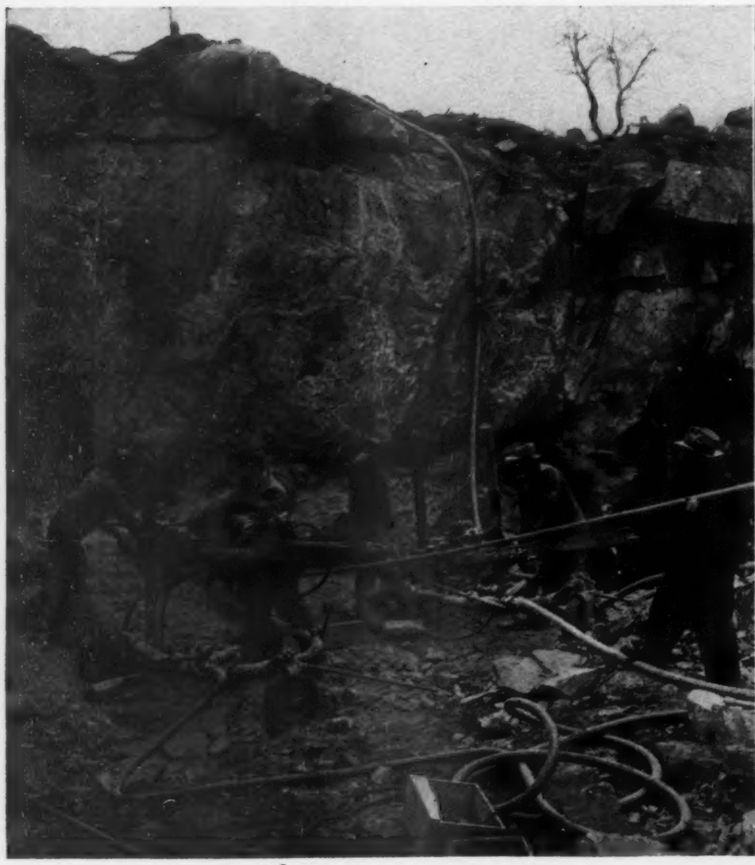
THE Monument to the Revolution, financed with money raised by voluntary subscription throughout the Republic of Mexico, has recently been completed. It is located in Mexico, D. F., at the center of the Plaza of the Revolution, which has an area of nearly 7½ acres and which, because of its magnitude and symbolism, is the most important civic center in the country. The monument stands in the principal axis of the city, and with a height of 213 feet is the tallest structure there. From its top on a clear day one may see as far as the Pyramids of San Juan Teotihuacan.

The monument is built on the highest point of the plaza, and is approached through wide avenues. It is surrounded by sunken gardens, and the view from each of these is different and interesting. Two of these gardens each have two imposing staircases and a basement of stone. Under the stairs are large water fountains whose cascades issue from the interior of the monument. The plaza is illuminated indirectly by lights on eighteen stone pillars, on which also are mounted flood lights that play upon the structure.

The monument is formed of four large *chiluca*—a variety of porphyry—arches, each 60 feet wide and 85 feet high, which support a double dome, an inner one of stone, measuring 74 feet in diameter, and an outer one sheathed with copper. The monument may be ascended by two elevators. One of these is vertical and the other follows a curved line to the top.

Four heroic sculptured stone groups, 38 feet high, close the quadrangular base of the monument. These represent "Independence," "The Reform Laws," "The Labor Laws," and "The Agrarian Laws," and commemorate the four great conquests of the revolution, which started with the War of Independence in 1810. The figures themselves do not represent individuals, but are allegorical. Each portrays a strong Mexican type. More than 30 of the country's sculptors competed for the honor of creating these figures, and they were executed by Sr. Oliverio Martinez, the winner of the contest.

The beauty of the monument lies in its vast proportions and the fine balance of masses and materials. The combination of volumes and planes exemplifies the pleasing and aesthetic effects possible in modern architecture by the use of simple lines. The design, construction, and technical execution of the monument were directed by Sr. Carlos Obregon Santacilia, one of the best-known architects in Mexico. The structure is a modification of what was originally intended to be the Legislative Palace. The work of reconstruction was started on August 14, 1933.



DRILLING HORIZONTAL HOLES

The drilling plan for each blast called for two rows of horizontal holes in the rock face and one or two rows of vertical holes on top of the cliff. Here are two wagon-mounted X-71 drifter drills putting in 24-foot snake holes at one end of the contract while loading was proceeding at the other end.

Roadbuilders Turn Quarrymen

Allen S. Park

A ROAD construction job that turned out to be almost a quarrying operation is nearing completion at Elmsford, in Westchester County, New York. Within a stretch 225 feet long and 150 feet wide, the latter being the width of the right of way, there was removed 32,000 cubic yards of rock. Using effective modern equipment, a well-organized force of workmen excavated this rock at an average rate of 700 cubic yards each 8-hour working day.

The removal of the rock constituted the principal work involved in straightening and reducing the grade of a short link in the Tarrytown-White Plains State Highway in the western part of Elmsford. It will eliminate a dangerous curve and will run directly through the toe of a rocky spur that the road now skirts. The work is being done by the Cerrone Construction Company, of Mt. Vernon, N. Y., which began operations on February 2 of this year.

LOADING OPERATIONS

The two shovels kept a fleet of eight trucks busy hauling the rock to a disposal site four-tenths of a mile distant. Three portable compressors were housed in the structure on top of the cliff, and a 4-inch line delivered the air to the drills.

RESULT OF A BLAST

The method of drilling and blasting made it possible to shoot down at one time hundreds of tons of rock, including numerous large bowlders. The latter were block-holed and reduced to sizes that the shovels could handle.

The section of highway under consideration runs east and west. A hill 100 or more feet in elevation lies on the south side of it, and it was through the lower slope of this rise that the cut was made. The depth to grade is only a few feet on the north side of the right of way, but it increases rapidly towards the south because of the upward slope of the terrain, attaining a maximum of 33 feet at the southern boundary line. Ordinarily, such a cut would be driven straight through from the two ends, but in this instance the contractor decided, by reason of the existing conditions, to make a side attack on the rock at the eastern and lower end of the section. In other words, excavating at that end was begun in the shallower stretch and carried progressively into the hillside. This enabled the operations to be extended over a greater length of the rock area than would have been possible by working straight across the 150-foot-wide right of way.

From an operating standpoint, this procedure was of advantage in that it served to expedite the work and effect economies as well. It made it feasible to bring down a long section of the retreating rock cliff with each blast, thereby providing an ample supply of broken material and insuring uninterrupted loading and hauling operations. It also permitted following a drilling and blasting scheme that would bring down the rock at a low cost per cubic yard. A further advantage of removing a sizable portion of the cliff at one time was that it cleared a space in which two power shovels could work simultaneously, with the consequent speeding up of loading and trucking operations.

After the cliff had been penetrated for a considerable distance under this plan, another opening was made at the western or upper end of the cut. At that location, operations were carried straight across the road line, at right angles to the right of way. With two working faces thus available, it was possible, during the latter part of the job, to alternate drilling and loading operations between them, with the result that all men and equipment were kept busy and nonproductive time was eliminated. For example, while material shot down at the lower end of the cut was being excavated, drillers were putting in holes at the upper end, and these were ready for shooting before all the broken rock had been removed from the other working area. Following this program, it was practicable by blasting every second day to provide an ample supply of rock to keep the shovels and fleet of trucks occupied to capacity.

The rock is a light-colored, fine-grained, igneous kind classified as Fordham gneiss. The greater portion of it is very hard, but now and then a softer formation was encountered. There are few fractures in it, the only exceptions being occasional cleavage planes which are generally more or less horizontal. As the work progressed and the cliff became higher there were sometimes as many as three of these seams across the working face.

The drilling plan called for both vertical and horizontal holes. Close to the bottom of the working face there was put in a row of horizontal snake holes spaced 5 feet apart. Five feet above these, and staggered with them, a second line of horizontal breast holes was drilled. All holes in both these rows were 24 feet deep and they were drilled with X-71 drifter drills on Type FM-2 pneumatic-tired wagon mountings. After the rock face had reached a height of 10 feet, supplemental down holes were drilled. On top of the cliff, parallel with and 20 feet back of the edge, a line of holes was put down on 5-foot centers. These were inclined slightly toward the base of the cliff so that the explosive could exert a lifting force. The depth of these holes varied with the height of the cliff. They

GENERAL VIEW OF WORK

The new highway will go straight through the hillside in the middle distance, eliminating the turn in the present road at the right. The cut will be 33 feet deep on the uphill side. The road is a state highway linking White Plains and Tarrytown.

became progressively deeper as the work proceeded, attaining a maximum of 30 feet, and were put down with one of the two X-71 drills used for the horizontal holes but placed for the purpose on a Type D mounting, which is suitable for operations with 30-foot steels. Depending upon rock conditions, a second row of vertical holes was sometimes drilled 5 feet back of the first one. These also were spaced 5 feet apart and were staggered in relation to those in the first row.

All drilling was done with Ingersoll-Rand Jackbits. Each bit was resharpened two or three times, which means that it was used three or four times before it was discarded. Bits were reconditioned by two New York firms, the Rock Bit Service Corporation and the Central Iron & Steel Corporation. These called for the dulled bits and delivered them after they had been resharpened. With new bits, each averaged about 4½ feet of drilling before resharpening was required. After a bit had once been resharpened, it drilled on an average about 4 feet of hole before further reconditioning became necessary. Approximately 6 inches of drilling sufficed to dislodge a cubic yard of rock. Most bits purchased were in the size range of 2¼ to 2¾ inches, the smaller sizes needed being obtained from these by regrinding.

Compressed air for operating the drills was supplied by three Ingersoll-Rand portable compressors—two air-cooled models of 315 cfm. capacity each and a water-cooled unit with a capacity of 310 cfm. These were housed in a frame structure on top of the cliff, and discharged into a 4x10-foot receiver from which a 4-inch delivery main, with frequently spaced connections for take-offs to the drills, extended along the top of the cliff.

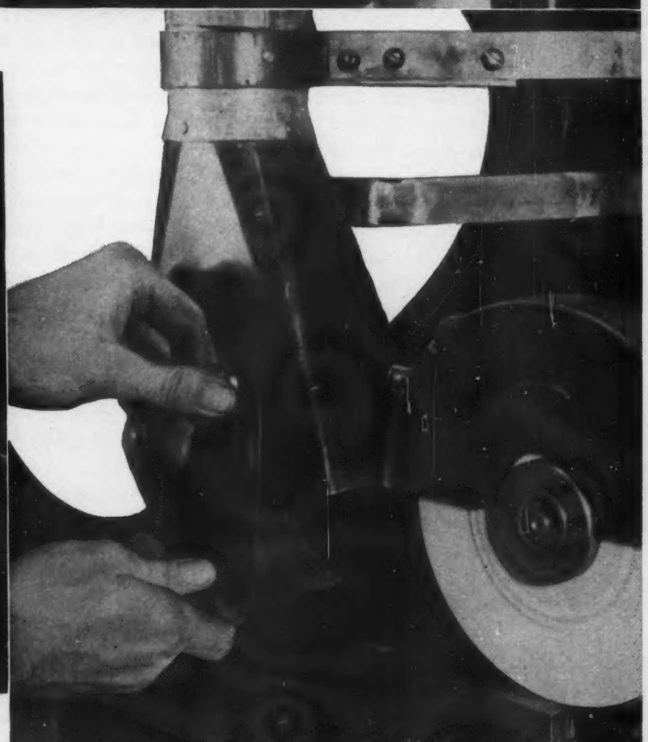
The holes were loaded with Burton 40 per cent gelatine dynamite in 1¼-inch cartridges. The horizontal holes in the lower row were charged with sufficient explosive to insure good lifting action, the amount varying with the nature of the rock. The breast holes in the higher line were loaded with only about one-third as much powder as was used in the bottom row. The loading of the vertical holes was governed by the number of seams in the face of the cliff, the column of powder being broken by tamping wherever there was evidence of a seam.

As the work was conducted in a built-up section and there were a number of houses and business structures within a radius of a few hundred feet of it, and as the existing highway passed directly alongside it, care had to be observed in blasting. As already mentioned, the main blasts were fired only once every two days. This was done after working hours, with all traffic on the adjoining road stopped and with woven wire mats laid over the horizontal holes at the base of the cliff to prevent rock from flying. Powder consumption varied with rock conditions. The blaster was informed by the drillers as to the character of the rock; and he loaded the holes accordingly.

The rock thus blasted down was loaded into trucks by an Osgood 2-cubic-yard, gasoline-powered and a Bucyrus-Erie 1¼-cubic-yard, gas-air-powered shovel. Bowlders too large to be handled were blockholed with S-68 Jackhamers to reduce their size. There were six of these drills on the job. Eight trucks were employed for hauling, the rock being moved about four-tenths of a mile to a disposal area designated by the Town of Elmsford.

A few hundred feet east of this rock area, the highway will cross the Sawmill River Parkway, which runs north and south, by means of an existing underpass. Between this crossing and the business section of Elmsford, several hundred feet away, the Sawmill River flows in a general north and south direction. The present road jogs to the northward, crosses the stream, veers back to the south for a short distance, and then makes a right angle turn into the Elmsford business section. The current work involves the straightening of this short stretch. A new bridge is being constructed not far downstream from and west of the existing structure, and the channel of the Sawmill will be shifted so that the river will flow under the new bridge instead of to the east of it as it now does. Included in the contract of the Cerrone Construction Company is the relocation of the channel. This will call for the excavating of approximately 13,000 cubic yards of dirt; and the surplus, after backfilling the old channel, will be used for surfacing the roadway through the rock cut together with its approaches.

The work described is being done for Thomas A. Brogan, the general contractor, and is being directed by Robert J. Cerrone. Al Crockett served as superintendent for the Cerrone Construction Company until he took charge of another job for that company and was replaced by Joseph D'Onfro. James J. Bixby is district engineer for the State Department of Public Works, with Joseph Brady as county assistant and Karl Erickson as engineer in charge of the project.



HOW ONE FACTORY SAFEGUARDS ITS WORKERS

ILLUSTRATED here are a number of safety devices used in the Endicott, N. Y., factory of International Business Machines Corporation and given publicity by that concern in the hope that the ideas embodied in them may be helpful to other companies in safeguarding their employees. The portable compressed-air nozzle at the top, left, has been equipped with a guard to prevent metal chips from flying back in the operator's face. The punch-press operator shown at the top, right, cannot get his hands caught, for the manacles he is wearing pulls them away from the die as it descends. The transparent guard on the wire-cutting machine pictured just above prevents the operator from inserting her hand while the cutting mechanism is working. The cover on the grinding wheel at the right, center, prevents particles from flying while the hood at the left exhausts metal dust. The paper cutter shown at the right has been arranged so that the operator must have both hands in the positions shown to make the knife descend. It is therefore impossible for him to be injured.

International Business Machines Corporation initiated a safety program twelve years ago, and goes far beyond the requirements of the law in protecting its workers. A full-time safety supervisor has under him a safety inspector, a fire inspector, a central safety committee of plant executives and supervisors, and a safety committee of 40 workmen. Regular meetings are held, and full reports are made on every accident that necessitates medical attention. The Endicott plant has frequently won safety awards, and last year led all industrial plants in New York with nearly 2,000,000 man-hours without a lost-time accident. That record has now been increased to more than 4,000,000 man-hours, and the company is striving to break its best previous record of 4,570,064 man-hours. The plant employs 4,000 persons and operates 6,000,000 man-hours a year.

Record-Breaking Diving Suit

IN THE January, 1938, issue of this magazine brief mention was made of the diving feat performed on December 2, last, by Max E. Nohl in the chill waters of Lake Michigan. Wearing a diving dress of a new kind and breathing air containing a percentage of helium—a departure in diving practices—he descended without ill effects to a depth of 420 feet, breaking the world's record by more than 75 feet. Since then we have been able to get the inside story about the suit which made that deep submergence possible, or at least so much of it as the manufacturer, Collord, Inc., can tell without divulging trade secrets.

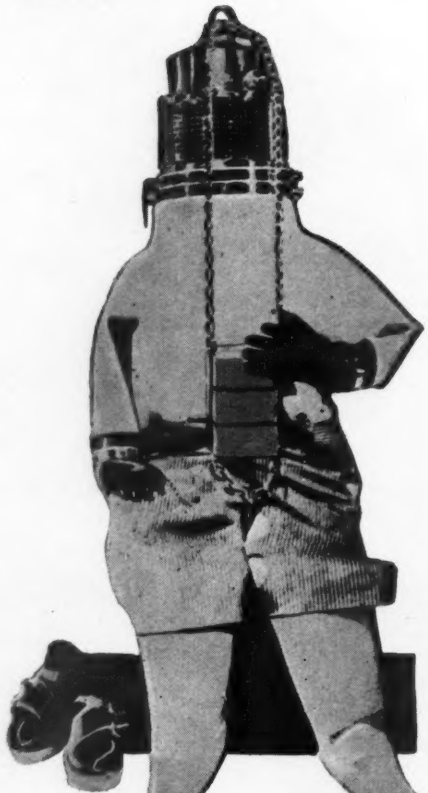
The diving dress was designed by Mr. Nohl with the assistance, financial and otherwise, of Capt. John D. Craig, well-known adventurer, explorer, and Hollywood motion-picture producer. "It was developed," to quote Mr. Nohl, "for our own deep-water salvage operations; but, because of the apparent need of a suit of low cost capable of meeting the varied and exacting requirements of the service, we are considering its production on a commercial scale. After numerous unsuccessful attempts to have it made by concerns equipped for such work, the job was entrusted to Collord, Inc., which specializes in the manufacture and application of rubber compounds."

A pattern was first made, and from this was cut a canvas foundation. After it had been carefully sewed together, rubber in solution was applied to both the outer and the inner surfaces by means of the company's Surfaseal method. The coats formed varied in thickness from 1/16 inch on the inside to ⅛ inch on the outside, with the exception of the shoulder and neck section which was built up to a maximum thickness of ¼ inch. The result was a seamless suit from top to toe. It is the absence of seams, laps, or welts, together with the specially compounded latex used, that gives the diving dress its exceptional strength. This was borne out by the tests in Lake Michigan, when a pressure of more than 600,000 pounds, or 181 pounds per square inch, had to be offset at the maximum depth reached at that time.

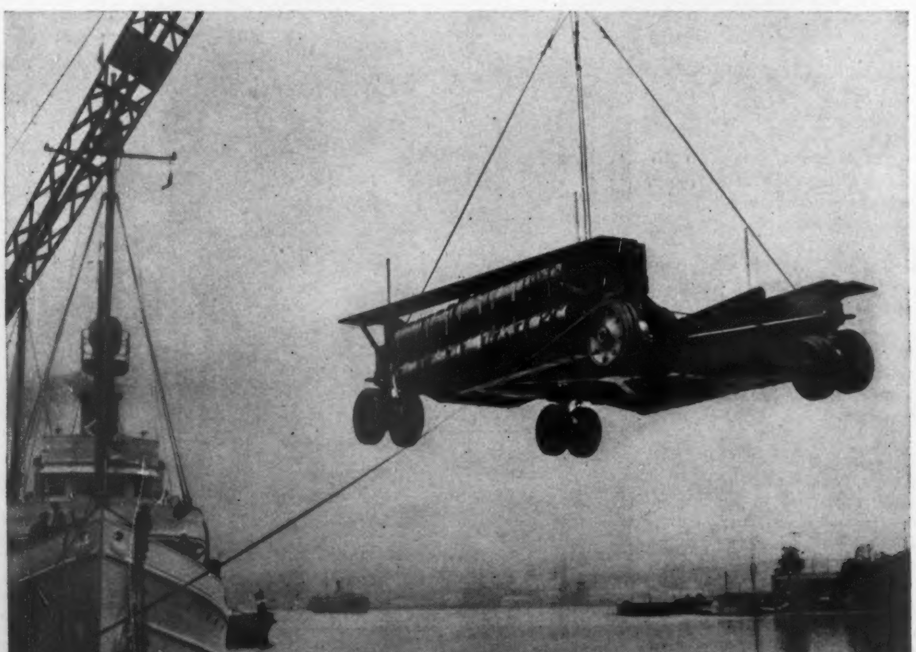
The suit itself is not cumbersome. Including the chafing pants with pockets and a knife sheath, it weighs only 30 pounds, or a little more than 12 per cent of the entire equipment. The helmet is made of aluminum and glass and weighs 45 pounds, the same as the lead front weights. The latter, together with the shoes of the same material, are necessary to overcome the buoyancy that would otherwise prevent the diver from descending.

The outfit is virtually a self-contained one—that is, the air required for breathing and to offset the crushing pressure that varies with the depth is not pumped to the diver from a surface craft through a hose connection but is carried in a cylindrical tank strapped to his back. The advantage of this is twofold: there is one less entangling line to worry about and there is less danger of the air supply being cut off. The tank weighs 60 pounds, and is charged with a mixture of oxygen and helium at a pressure of 2,000 pounds per square inch. It contains enough air to permit the diver to remain submerged for a period of 23 hours.

With the practicability of the new diving dress established, Captain Craig and Mr. Nohl, to quote the latter, "are planning to initiate elaborate salvage and underwater



motion-picture operations this summer on the *Lusitania*, lying at a depth of 312 feet off the Irish Coast, and also on the *Merida* 220 feet down off the coast of Virginia." By increasing the depth to which a diver can go, a vast realm containing millions of dollars worth of sunken treasure has been placed within his reach; and it is interesting to speculate on what will happen if the forthcoming salvage operations are successful.



DRY DOCK FOR NEW PLANES

This 15-ton structural-steel, amphibian cradle is being used at the Boeing aircraft factory in Seattle to assist in assembling the first of five 85,000-pound flying boats being manufactured there for Pan American Airways for service across the Atlantic and Pacific oceans. The hull of the new plane was mounted on this conveyance and towed outside the plant by a tractor to a location providing room for affixing the wings. When completed, the flying ship will be hauled into the water for launching. On either side of the 15x22-foot cradle are two long tanks. When charged with air, they provide the necessary buoyancy to float the cradle and its 45-ton load. By allowing the tanks to fill with water, the cradle can be submerged, and the plane launched. For beaching a plane following a test flight, the submerged cradle is maneuvered directly under it and the tanks blown free of water with compressed air. The cradle will then rise and take the load of the plane, after which it can be drawn ashore by a tractor. Two additional carriers of the same design are being built for use with flying boats that will come from the plant later.

Editorial

CHANGING TRENDS IN STEEL

TWENTY years ago we thought of steel primarily as a heavy, massive, inflexible material. Today we have a different conception of it. Much steel is still produced in the form of heavy sections; but an increasing proportion of it reaches the market as thin sheets or plates capable of being worked into a variety of shapes.

In 1927, the railroads consumed 19 per cent of the steel made in the United States, and the building industry used 22 per cent of it. In 1937, which was a banner year for the steel industry as a whole, the railroads took but 12 per cent and the building industry only 7.9 per cent. In other words, these two heavy industries were, proportionately, only half as important as steel consumers last year as they were a decade ago. The figures may not reflect the changing conditions accurately, as 1937 was admittedly not a big one for railroad and building-industry purchases; but they do indicate a distinct trend. That trend is towards greater diversification of steel products, with steel supplanting other materials in many fields.

In 1937, the automotive industry used 17.4 per cent of all the steel produced, as against 14 per cent in 1927, while the demand for steel for containers was 9.8 per cent, as compared with 4.5 per cent in the earlier year. Most surprising, however, was the "miscellaneous" consumption, which jumped from 17 per cent to 33.2 per cent during the decade. Most of the latter involved light products, and these went to so many different fields of service that it was not possible to classify them completely. Steelmen predict that this trend will continue, and they look to the future with optimism.

This pronounced and growing demand for lighter steels is attributable to the progressiveness of the steel producers. Their metallurgists have developed materials with specific properties for new uses, and their operating men have devised machines and methods for making these materials at costs sufficiently low to permit them to be sold at attractive prices. A brief review of the history of sheet-steel-production practices will demonstrate beyond a doubt that technological advance has created this vast new volume of business for the steel mills.

Steel was first rolled between cylinders in England in 1778, and continuous rolling was introduced into the United States in 1868. The mills were only two rolls high, however, and with such equipment the strip that could be made was definitely limited as to thinness and width. Only a little more than ten years ago, the 4-roll-high mill made its appearance. With two large rolls backing up and supporting the relatively smaller working rolls, it was possible to roll ribbons of steel 1/20 inch thick and in widths of 72 inches and more. Continued refinements and improvements in processes and equipment have brought about the modern, high-speed mills such as that described in the first article in this issue.

The 2-high mills of a few years ago could produce 60 tons of 16-gauge, 30-inch-wide material in 24 hours: one of the newer 4-high mills will do it in less than one hour. During the past three years alone, the steel industry has appropriated $630,000,000 for new rolling equipment and accessories, and a large part of that sum went into continuous-type mills. To put up such a mill, it costs about $35 for each ton of its total annual capacity. Yet, the resultant efficiency is so great that the capital investment can, it is calculated, be paid for by operating the mill at 75 per cent capacity for less than three years.

TRANSATLANTIC-SERVICE CENTENARY

ON APRIL 23, 1838, two steamships from England entered New York Harbor, and their arrival marked the inauguration of regular service across the Atlantic by steam-driven vessels. One of the ships was the *Great Western*: the other was the *Sirius*. The latter was the first to reach port, but to her rival is given the credit for being the first to demonstrate the practicability of steam navigation on the Atlantic.

The Atlantic had been crossed from west to east by the *Savannah* in 1819 and by several other steamers before 1838, but none of these passages was made with any attempt to establish regular service. When the idea of scheduled runs was finally accepted, it took hold with vigor, and three companies essayed to be in the vanguard. Although all these concerns were formed by British interests, an American was largely responsible for their inception. This man was Junius Smith, a successful lawyer and businessman.

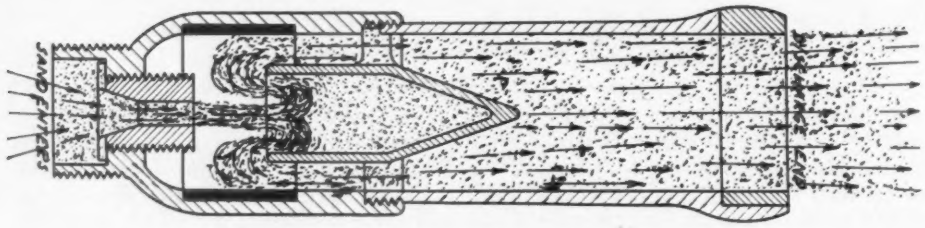
Irked by having had to spend twelve weeks in making a voyage from New York to London and return in a sailing vessel in 1833, Mr. Smith started a campaign among bankers, merchants, and shipowners for the purpose of establishing a service with steamers which, he contended, could easily make the one-way run in fifteen days. After many rebuffs and much ridicule, he succeeded, in 1836, in organizing the British & North American Steam Navigation Company, being greatly aided in this by the famous African explorer, Macgregor Laird. In October of that year a contract was placed for the building of the *British Queen*, an 1,800-ton ship with engines of 500 hp. Because of labor troubles, a second contract had to be let, and this delayed her first crossing to New York until July of 1839.

Meanwhile the Great Western Railway was being constructed from London to Bristol, and its guiding engineering genius, I. K. Brunel, conceived the idea of connecting Bristol with New York by steamer. Brunel was the son of the inventor of the compressed-air shield for tunneling in water-bearing soil. Although only 29 years old at the time, he was a clever promoter, and his transatlantic scheme caught on quickly. Together with other competent men, he formed the Great Western Steamship Company and designed the *Great Western*, a 1,340-ton ship, on which work was started on July 28, 1836.

The *Great Western* was launched on July 19, 1837, and 300 persons partook of luncheon in her main saloon on that memorable occasion. By the end of the following March she was fully commissioned, and the word went forth that she would soon set out on her epochal trip. The British & North American Steam Navigation Company had been working feverishly to finish the *British Queen*, and when they learned that they were going to be too late, they chartered the *Sirius*, a 703-ton ship that had been built in 1837. She left Cork a few days before the *Great Western* was scheduled to sail from King Road at the mouth of the Avon River. After a voyage of eighteen days she arrived off New York on April 22, and steamed up the harbor the following morning. The *Great Western* reached New York the same day, having left England four days after her rival. The *Sirius* made only two round trips before being returned to her owners, who used her for service in the British Channel. The *Great Western*, on the other hand, continued in transatlantic service until 1846.

The *Royal William* and the *Liverpool* also crossed the Atlantic in 1838. The latter was purchased by the Transatlantic Steam Ship Company, a Mersey organization, while she was under construction. Following the example set by the London company, the owners, without waiting for her completion, chartered the *Royal William* for the first run. She covered the distance to New York in eighteen days, arriving there on July 5, 1838. The *Liverpool* made her initial crossing the following November.

From these beginnings, regular steamer service across the Atlantic was soon established. In 1840 the Cunard Company built the *Britannia* and three sister-ships to run between England and Halifax. As the Cunard Company is still a power in the commercial maritime field, it is very likely that the centenary of the *Britannia* will be fittingly observed two years hence.

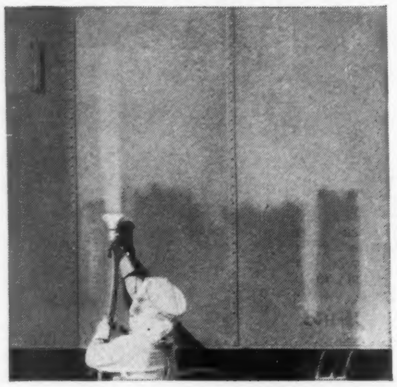


Improved Type of Sand-Blast Gun

AFTER several years of service in the Wichita, Kans., shops of the Atchison, Topeka & Santa Fe Railway, an improved type of sand-blast gun is now available for general use. It is the invention of Frederick W. Schultz, superintendent of the shops mentioned, and is employed there for cleaning steel-sheathed and wood refrigerator cars preparatory to refinishing them.

The structural features of the gun, as the accompanying longitudinal section shows, consist essentially of an intake nozzle and chamber, of a baffle cup, and of an outlet chamber and nozzle with a flat-mouthed orifice. Upon leaving the air hose, the sand is impelled against the walls of the baffle cup, thus building up the pressure and setting up a whirling motion that breaks up the particles and increases the number of cutting edges. Next, after its flow has been momentarily reversed, the sand passes along the outer wall of the baffle into the outlet chamber, whence it is discharged in a flat stream under uniform pressure. The outlet nozzle comes in standard widths of 2, 3½, and 4½ inches, and is protected against abrasive action by replaceable lips made of alloy steel. The gun can be connected to any line delivering compressed air at a pressure of from 80 to 100 pounds per square inch.

According to the manufacturer, the Michiana Sand Blast Gun, the name under which it is being sold, has numerous advantages over existing types. It is easy to handle, weighing only 1½ pounds. It permits the use of lower-cost sand and cuts down the air consumption by about 30 per cent. Because of the spread of the flow it not only does its work of removing grime, grease, and old finishes in less time but it also prevents cutting and pitting even light-weight materials that have heretofore generally not been sand-blasted. Exclusive license to manufacture the gun has been granted the Michiana Products Corporation.



IN SERVICE

The gun at work cleaning the outer surface of a steel-sheathed railway car preparatory to repainting it. The longitudinal section at the left shows the structural features of the gun and how it operates.

INTERIOR OF NEW ARMY STRATOSPHERE PLANE

Maj. Carl Greene (right), who has charge of the U. S. Army Air Corps' pressure-cabin project at Wright Field, Dayton, Ohio, conferring inside the new stratosphere plane with Maj. Albert W. Stevens, coholder of the world altitude record of nearly 14 miles. The plane is designed for flying at altitudes of 30,000 feet and higher without the use of oxygen equipment because the interior of the cabin will be under pressure. The air for charging it is compressed in a centrifugal blower that is driven by a turbine which receives its power from the exhaust of the engines. When flying at 30,000 feet, the cabin will be maintained under a pressure of about 5½ pounds per square inch. The air breathed by the occupants will therefore have approximately the same density as normal atmosphere at an altitude of 10,000 feet. The flow of air through the cabin will amount to about 150 cfm.

Gas from Coal at Mine

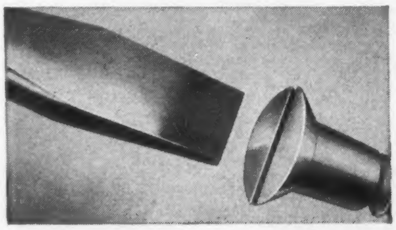
GASIFICATION of coal *in situ*, which has engaged the attention of Russian scientists for some years, has reached a practical stage, according to the director of the Soviet Underground Gasification Trust. The problems involved have been exceedingly difficult, owing to the many different kinds of coal, the varying thickness and depth of the seams, and the fact that a gas suitable for one purpose will not meet the needs of another. However, the stumbling blocks have apparently been overcome, as the Government is now constructing several such plants for the manufacture of gas on a commercial stage.

The experiments were conducted in five mines with coal ranging from anthracite to lignite, and with coal crushed by mechanical means and coal in the natural state. In the case of the latter, air charged with varying quantities of oxygen was blown through the beds as part of the process of gasification. The result of these tests is an underground generator, together with a method of production, that makes it possible, regardless of existing conditions and the character of the coal, to control the chemical composition of the gas. For example, at the Gorlovka experimental mine in the Donetz Basin, where approximately 388,500,000 cubic feet of gas has been manufactured, the product could be changed at will from "power gas," suitable for firing boilers in electric generating stations, to "process gas" suitable for making benzine and ammonia or for the direct reduction of metals from ores. This was done by increasing or by cutting down the oxygen content of the air. The cost of production averages half a kopek per 1,000 heat units, but it is believed that it will be reduced anywhere from 30 to 50 per cent when the underground installations are in full operation.

Industrial Notes

Four freight cars, each with a capacity of approximately 50 tons, could carry all the gold produced in the United States in 1937. The output totaled 4,752,801 ounces valued at $168,348,035.

A screw driver that is designed not to skid is being offered by the Bridgeport Hardware Manufacturing Corporation. The blade of the new tool, called the Non-Skid, is of chrome-vanadium steel and has a patented, grooved tip. It is firmly embedded in a handle of Ebonoy, a material



that was made especially for the purpose and that is said to be highly insulated and practically unbreakable.

Liquid Heat is the general name under which E. F. Houghton & Company is offering five new salts for heat-treating high-speed steel. They are used, respectively, for preheating, for high heat, for quenching, for drawing, and for final case hardening.

Garages with showers and dressing rooms for chauffeurs are being built under the approaches to several new bridges now in course of construction across the Moscow River at Moscow, Russia. These garages will accommodate 2,000 taxicabs, or twice as many as are now in use there. Here is a hint for some of our congested cities, like New York.

To prevent eyestrain, workers in offices, shops, and factories can be assured adequate light at all times by the use of a new device designed by the Electronic Products Company. The equipment is connected in series with a wall switch and will automatically turn the lights on and off as many times a day as natural light drops below or again reaches a predetermined figure.

In anticipation of the day when our petroleum reserves will no longer be equal to the demand, the U. S. Bureau of Mines has recently completed a continuous hydrogenation plant at its Pittsburgh Experiment Station. There the Bureau will study the composition and properties of the various domestic coals for the purpose of determining which ones are best suited for combustion and which for carbonization, gasification, or liquefaction.

The expectations are that a plant will be put in operation sometime this year in which feldspar, quartz, and mica will be separated by means of froth flotation. This is the result of investigations conducted by a group of feldspar companies in an effort to recover the feldspar in waste dumps and in pegmatites in which the mineral is so mixed with quartz and other impurities as to make extraction by ordinary methods difficult.

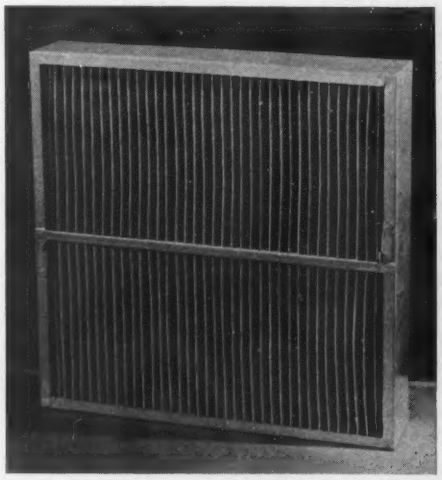
Small and compact standard-duty push-button stations designed to resist oil and dirt in machine-tool service are being made by General Electric Company. Between the button proper and the bushing or oil guard of these stations is a graphited packing ring that prevents oil or grease from an operator's gloves or hands reaching the button mechanism. To meet the varied requirements of the industry, the line includes flush-mounted, surface-mounted, momentary-contact, and selector switch units.

Molded Specialties Company has developed a nozzle for industrial use that can be manipulated to deliver a jet of either compressed air or water or water and air combined for a multiplicity of services such as washing, flushing, drying, degreasing, etc. It is provided with a $\frac{3}{4}$-inch hose connection for water and a connection for a $\frac{1}{8}$- or $\frac{1}{4}$-inch air line, and has a reversible mixing cap at the delivery end that permits the discharge of a spray or a solid stream. The list price of the No. 4 Pressure Booster, as it is called, is $4.85. It weighs $1\frac{1}{2}$ pounds.

For protecting and at the same time decorating the surfaces of rubber, metal, wood, and glass, the Detroit Macoid Corporation has produced two cellulose-plastic coatings which are being offered under the names of Macoid and Cellucraft. Both can be pigmented to give a variety of either transparent or opaque color effects, and are claimed to be highly resistant to abrasion, wear, exposure, and chemical attack; to be impervious to gasoline, naphtha, oils, and greases; and to have good dielectric and insulating properties. They are applied by dipping and spraying, respectively, which, together with curing, can be done at ordinary room temperature.

Ex-Senator Tornado gets a job testing air gauges.

A new dry-type of air filter for domestic and industrial air conditioning has been announced by Staynew Filter Corporation. The unit is of the well-known Protectomotor fin construction and is strongly reinforced with wire mesh. This gives it its name of Wire-Klad, and makes it possible under normal circumstances to clean the filter well-nigh indefinitely with high-pressure air or by suction. When exposed



to oil or grease it is necessary to use a solvent and to lift the filter insert out of its frame. Several kinds of filtering media are available to meet varying service conditions. Cotton and a felt-like material of wool, called Feltex, are most commonly used. The latter is said to be practically impervious to even microscopic particles of dust while offering very little resistance to the flow of air. The advantages claimed for the Wire-Klad are: ease of cleaning; low replacement cost of wire-reinforced filter insert; large filtering area in a small space; and flame resistance—the unit meets certain requirements of the National Board of Fire Underwriters. Standard sizes are available and special sizes are made upon request.

All the facts, including methods of application and costs, about Dresser No-Thread Fittings, Style 65, are contained in a well-illustrated 16-page booklet recently published by S. R. Dresser Manufacturing Company. For those not familiar with this type of fitting, it should be added that it consists of a malleable-iron sleeve which joins plain pipe ends. At each end of the sleeve is a nut which, when tightened, compresses a resilient rubber-compound gasket around the pipe. All that is needed is a wrench to tighten the nuts, and the result

is a joint that is said to be flexible, permanently tight, and suitable for oil, gas, water, air, and other lines. The booklet can be obtained by writing to S. R. Dresser Manufacturing Company, Bradford, Pa.

Ingersoll-Rand Company, New York, N. Y., has recently published a 28-page bulletin covering its full line of single-, 2-, and 3-stage steam-jet ejectors for the removal of air, gas, or vapors from condensers and vacuum chambers in industrial processing. In addition to listing their applications and explaining their characteristics, the bulletin describes and illustrates the structural features, operation, and arrangement of the various ejectors with precoolers and intercondensers and aftercondensers of either the surface or barometric type. Several pages are given over to operating hints and to associate equipment. A copy of Bulletin No. 9046 may be obtained from the main or branch offices of the company upon request.

Vacuum cleaners are generally associated with dust and dirt; but along comes the Spencer Turbine Company and adapts portable machines so that they will also take up water left standing on floors in the course of regular scrubbing operations. The machine includes a separator in which the water is collected and held for subsequent drainage through an outlet valve. Suction for the work is induced by a $\frac{3}{4}$-hp., motor-driven blower provided with an extension cord that permits it to be plugged into any light socket. It is claimed that wet and dirty floors over which the machine has gone are left clean and dry. Aside from routine operations, such a unit might come in handy in an emergency—broken plumbing, for example—and serve quickly to remove large quantities of water that might otherwise seep through floors and do considerable damage.

Searching for lost Cardox shells in a group of collieries where more than 1,200 are in use daily was no small job until the man assigned to that work was provided with an electrical detector. In the Zeigler Mines of the Bell & Zoller Coal & Mining Company, in Illinois, an accurate check is kept on all cartridges delivered to and returned from the different workings, and any that are missing have to be found. The detector that now assists in locating them consists of earphones and of a box containing batteries and other parts much like those in a radio. The power box has long handles to which are attached a loop aerial—26 turns of wire around the wooden rim of a 26-inch bicycle wheel. When approaching within a foot or so of a buried metal object, the normal buzzing of the earphones dies down, thus indicating its presence to the wearer. It takes much less time and effort to uncover lost shells in this way, not to mention stray tools, etc. Cardox shells are metal tubes charged with a gas and are extensively used in coal-mining.